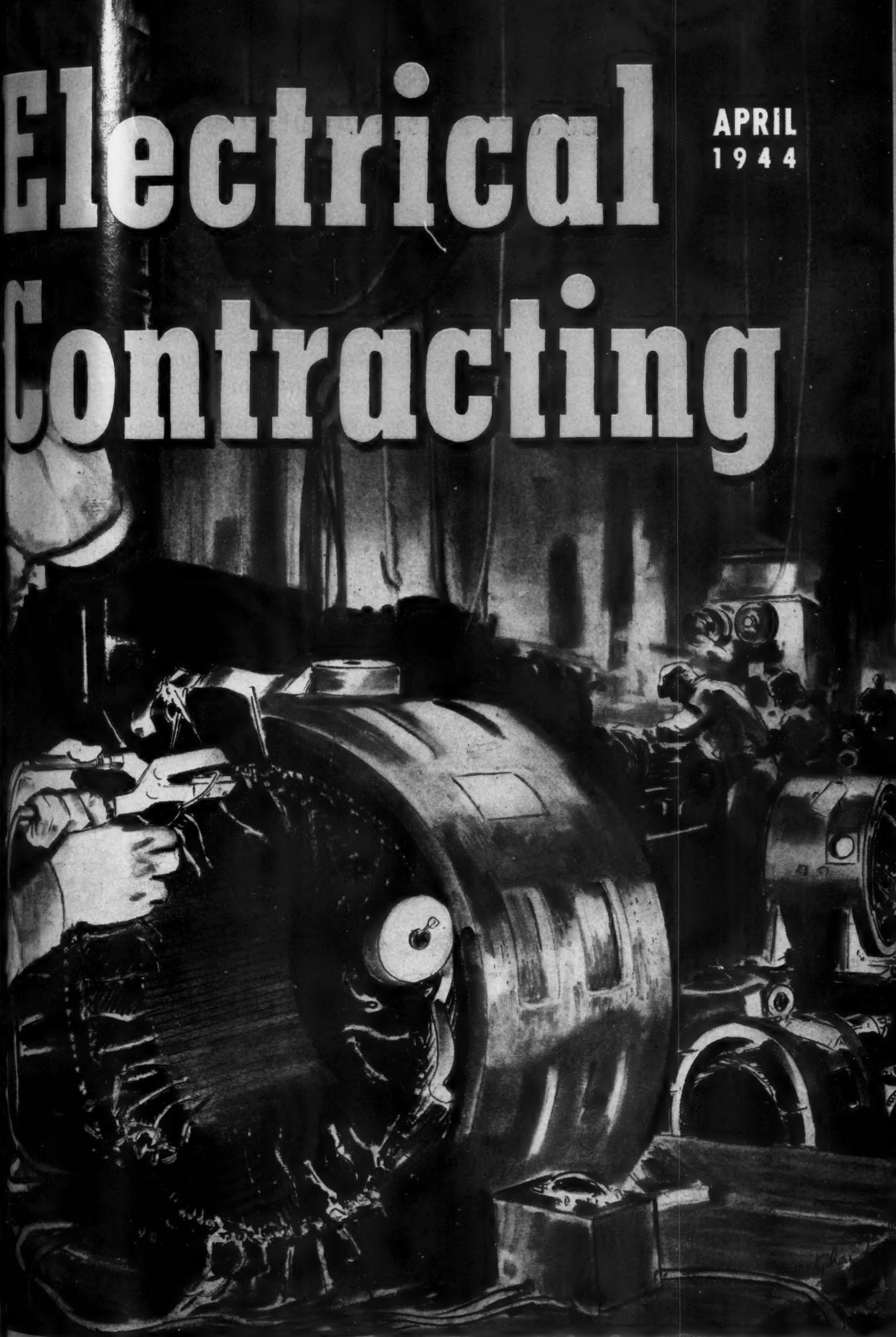


Electrical Contracting

APRIL
1944



The Magazine of ELECTRICAL CONSTRUCTION AND MAINTENANCE

YOU CAN RENDER ADDITIONAL SERVICE
by offering properly planned
FLOODLIGHTING

TAKE ADVANTAGE OF G-E TECHNICAL ASSISTANCE
 AND THE WIDE RANGE OF NOVALUX EQUIPMENT

• Maybe you never expect to "see your name in lights." But every good job of floodlighting you install enhances your reputation. Therefore, take advantage of the twofold help offered by General Electric:

1. An extensive line of moderately priced, high-quality floodlights which will enable you to meet any floodlighting requirement. Typical of the G-E line are the popular units illustrated, and listed below.

2. Expert help in selecting and applying the right type and number of lights for the job. Such help is available from trained lighting specialists of General Electric and its authorized agents, or from the G-E Illuminating Laboratory at Schenectady.

As a first step to becoming *floodlighting headquarters* in your territory, get in touch with our nearest office, or authorized agent. *General Electric Company, Schenectady, N. Y.*

A few of the more popular NOVALUX FLOODLIGHTS

| TYPE | WATTAGE | GENERAL CLASSIFICATION | APPROXIMATE ¹ PRICE RANGE |
|------|----------|------------------------|--------------------------------------|
| L-66 | 200 | General Purpose | \$12.50 |
| L-38 | 200/250 | Heavy Duty | \$43.00 |
| L-49 | 300/500 | General Purpose | \$27.00 to \$40.00 |
| L-30 | 300/500 | Heavy Duty | \$68.00 |
| L-43 | 750/1000 | General Purpose | \$31.00 to \$50.00 |
| L-45 | 750/1500 | Area Floodlight | \$17.00 to \$25.00 |
| L-46 | 750/1500 | Area Floodlight | \$28.00 to \$36.00 |
| L-68 | 750/1500 | Area Floodlight | \$31.00 to \$74.00 |
| S-18 | 900/1500 | Searchlight | \$200.00 to \$320.00 |

¹ List prices subject to your usual discount.



NOVALUX

Floodlights



GENERAL **ELECTRIC**

451-90-3200

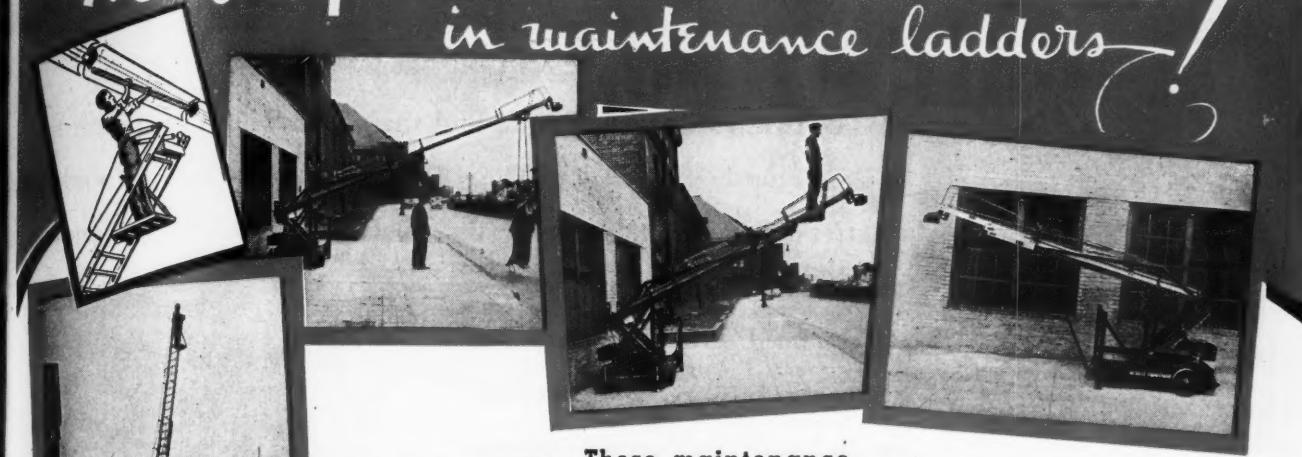
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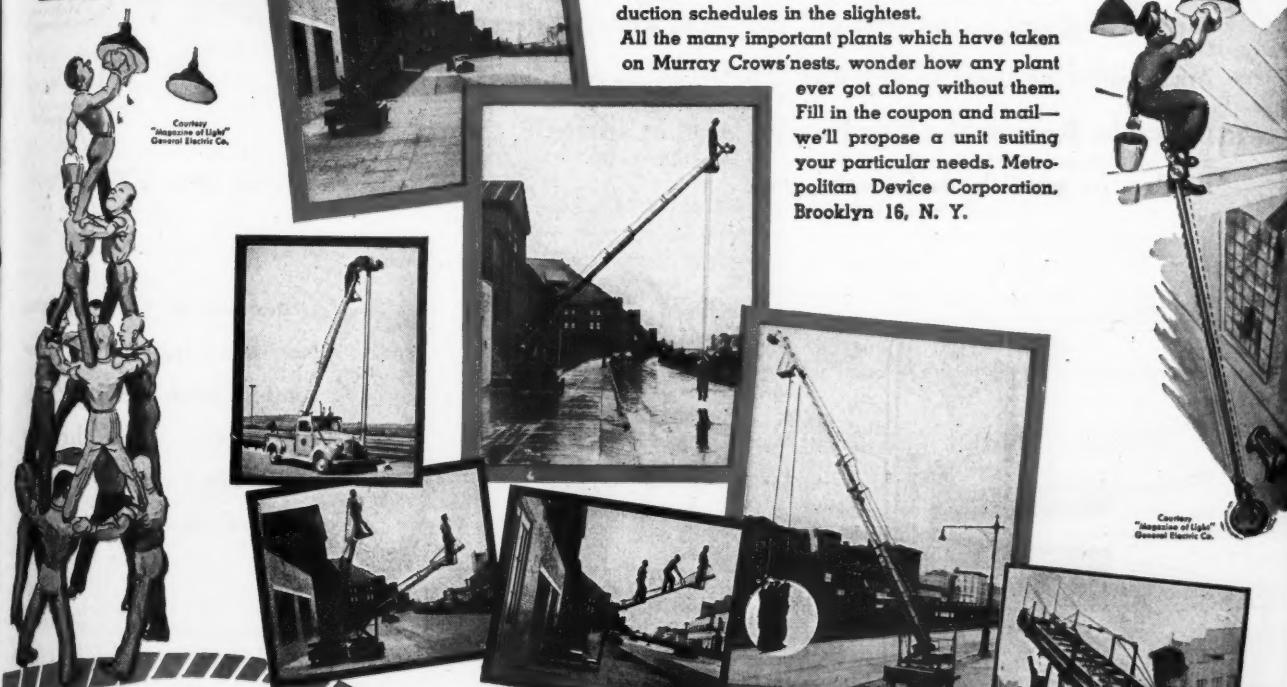
"Murray"—the modern STANDARD in maintenance ladders!



These maintenance units make overhead servicing so fast and easy that light output is kept at maximum.

The chief advantage of these Murray Crows' nests is that they make overhead, out-of-the-way lights, unit heaters and sprinkler heads, easily accessible, without disturbing men, machines or production schedules in the slightest.

All the many important plants which have taken on Murray Crows' nests, wonder how any plant ever got along without them. Fill in the coupon and mail—we'll propose a unit suiting your particular needs. Metropolitan Device Corporation, Brooklyn 16, N. Y.



Metropolitan Device Corp.
Brooklyn 16, N. Y.

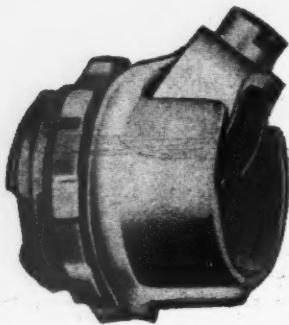
Send data (without obligation) on Murray Crows' nest suitable for our requirements.
Ladder must reach feet high, and extend
feet side-ways. Aisle width is feet.

Name and Title _____
Company _____
Address _____

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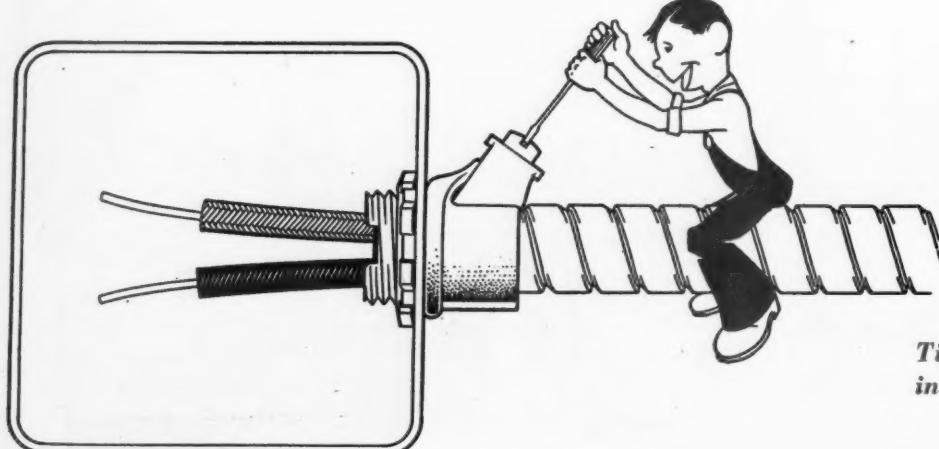
T&B TITE-BITE CONNECTORS

Especially Designed for ARMORED CABLE



ELECTRICAL CONTRACTORS find that T&B Tite-Bites insure safe and speedy installations. These fittings are tailor-made for work on all sizes of armored cable and flexible metallic conduit. Each connector takes several sizes. A small stock is all you need. Tite-Bite Connectors are particularly recommended for use in locations where vibration is constant. They're built to take it.

Note that the one screw forces the teeth of the Tite-Bite onto the convolutions of the armor of the cable without spreading or injuring them in any way. The screw never touches the cable. Because the biting wedge is set at an angle, the harder the pull, the tighter the grip.



Safe and Fast Installation

Order Tite-Bite Connectors from the stock of your local T&B Distributor through whom we distribute all our products exclusively.

WRITE TODAY FOR BULLETIN 15



THE THOMAS & BETTS CO.
INCORPORATED
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH 1, NEW JERSEY
In Canada: Thomas & Betts Ltd. Montreal



E Flag awarded April 1943
White Star awarded October 1944

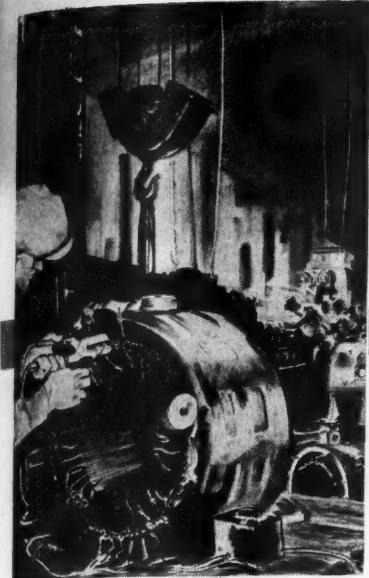
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Alice
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W. A.
R. E.
Harry

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F. J. S.
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A. B. C.

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OUR COVER this month is "Motor Service," the eighth in a series of original sketches of electrical equipment in wartime by Artist Stephen Grout.

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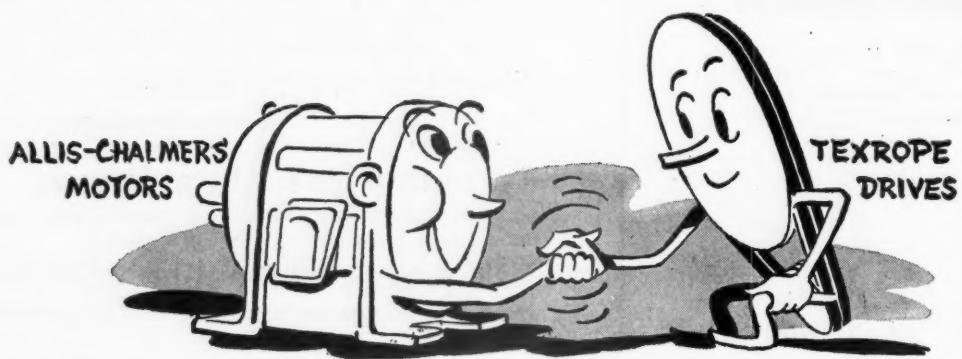
A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

Electrical Contracting

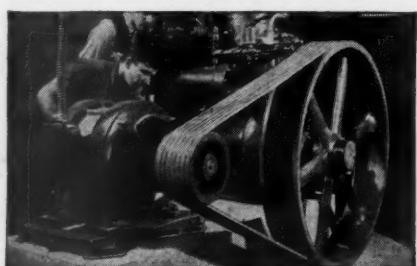
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A-C "Team" of Flexibility



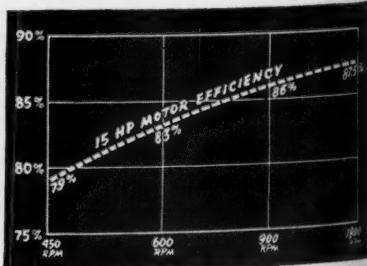
★ To drive low speed machinery with high speed motors (now that low speed motors are sharply restricted), Allis-Chalmers Tex-rope Drives can "gear down" motor speeds over a range of 7 to 1. As America's only builder of *both* motors and V-belt drives, Allis-Chalmers has long studied and advocated their use in proper com-



1 In most applications, an 1800 rpm motor with Texrope Drive will ably do the job of a lower-speed, direct-connected motor — at lower cost in money and materials!



2 When you buy an 1800 rpm instead of 450 rpm 15 hp squirrel-cage motor, for example, 600 lb are saved. And you save well over \$200 — with drive figured in!



3 Note that efficiency rises from 79% for the 450 rpm motor to 87.5% for the 1800 rpm motor. The 1800 rpm motor saves you over 30 kw/24 hr. day.



ALLIS-CHALMERS

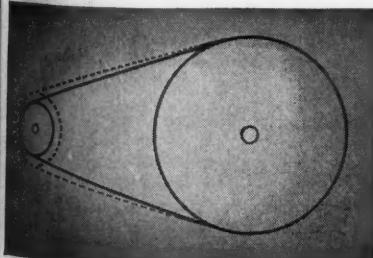
Electrical Contracting, April 1944

"Gives You y now needed

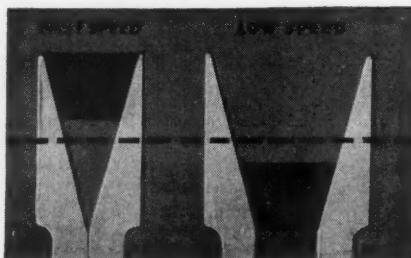
bination . . . today offers you the benefit of long pioneering experience. Texrope Drives are compact, highly efficient, protect your equipment by absorbing shock.

★ To drive a machine at different rates with a single speed motor (now that multi-speed motors are sharply restricted), Texrope Adjustable-Speed Drives give you infinite speed range up to 375%. And in Allis-Chalmers full line of Texrope Drive equipment you'll find the *right* range for your machines . . . thus avoid paying extra for more speed than you need. For engineering cooperation, feel free to call on your nearby Allis-Chalmers district office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

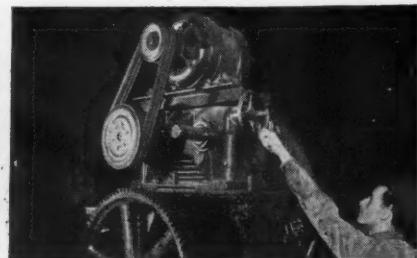
A 1706



4 Infrequently needed speed changes can be had by changing from one size motor sheave to another. Juggling complete drives, range is 1:1 to 7:1.



5 With the Allis-Chalmers Vari-Pitch Sheave, you can increase or decrease speed by adjusting sheave diameter . . . obtaining an unbroken series of speeds!

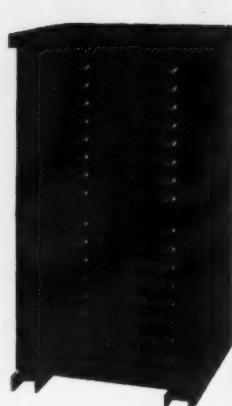


6 Allis-Chalmers Vari-Pitch Speed Changer gives you infinite changes at the turn of a wheel — within 3.75 to 1. It's compact, flexible, efficient!

SHALMERS

LO-MAINTENANCE MOTORS
TEXROPE DRIVES

Standard DRY-TYPE TRANSFORMERS



Standard Dry Type
Drip-proof Transformer
showing welded
steel, ventilated
cabinet. For indoor service
floor mounting.



Typical wall-mount-
ing construction, with
light durable expanded
steel mesh protective
enclosure.



Standard Dry Type Transformers are
made in sizes from 0.050 to 1000 KVA.
They are of modern design, economi-
cal and dependable.



For weather proof ser-
vice, Standard type MC
transformers are used.
Core and Coil are com-
pletely surrounded by
moisture-proof com-
pound.

Provide these Practical Advantages:

- 1 NO FIREPROOF VAULTS NEEDED for housing the transformer. The consequent saving of time and material is very worthwhile.
- 2 INSTALL NEAR LOAD CENTER, thus reducing long, expensive wiring installations and improving power characteristics at point of use.

* * *

Standard Dry Type Transformers may be installed anywhere—inside public buildings, in mines and factories. No liquids to constitute a fire or explosive hazard.

Made in many capacities, Standard Dry

- 3 COMPACT—and light in weight, saving floor space and permitting greater flexibility in arrangement of equipment.

- 4 EFFICIENT, ECONOMICAL—The efficiency of Standard Dry Type Transformers means economy of operation and low installation cost.

* * *

Type Transformers serve dependably and economically. Available with either Class A or Class B insulation. Drip-proof and enclosed cabinets can be furnished. Our nearest representative will gladly furnish complete details.

STANDARD TRANSFORMER CO. WARREN, OHIO

REPRESENTATIVES IN 29 PRINCIPAL CITIES

Makers of Distribution and Power (Oil or Non-Inflammable Askerol Cooled), Metering, Street Lighting, and Testing Transformers. Designs for Special Applications a Specialty.

SHORTS STYMIED

Voltage surges which accompany switching and frequent starting and stopping of motors impose high dielectric stresses on the coil insulation, and can cause harmful short circuits. Yet this is an unavoidable condition of service for many motors.

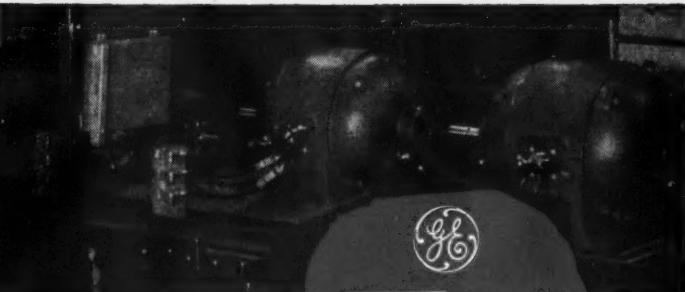
The grinder shown here, for example, starts and stops every time a finished part is removed and a new part inserted. But the two Tri-Clad motors that drive it have been built to withstand safely the voltage surges ordinarily encountered in this type of service. Their ability to "stymie" shorts was proved by the new General Electric test described below.



External grinder, equipped with two Tri-Clad motors, installed in the milk-machinery manufacturing plant of the Rite-Way Products Company, Chicago, Ill.

New high-potential, electronic surge-tester verifies strength of **TRI-CLAD** motor windings

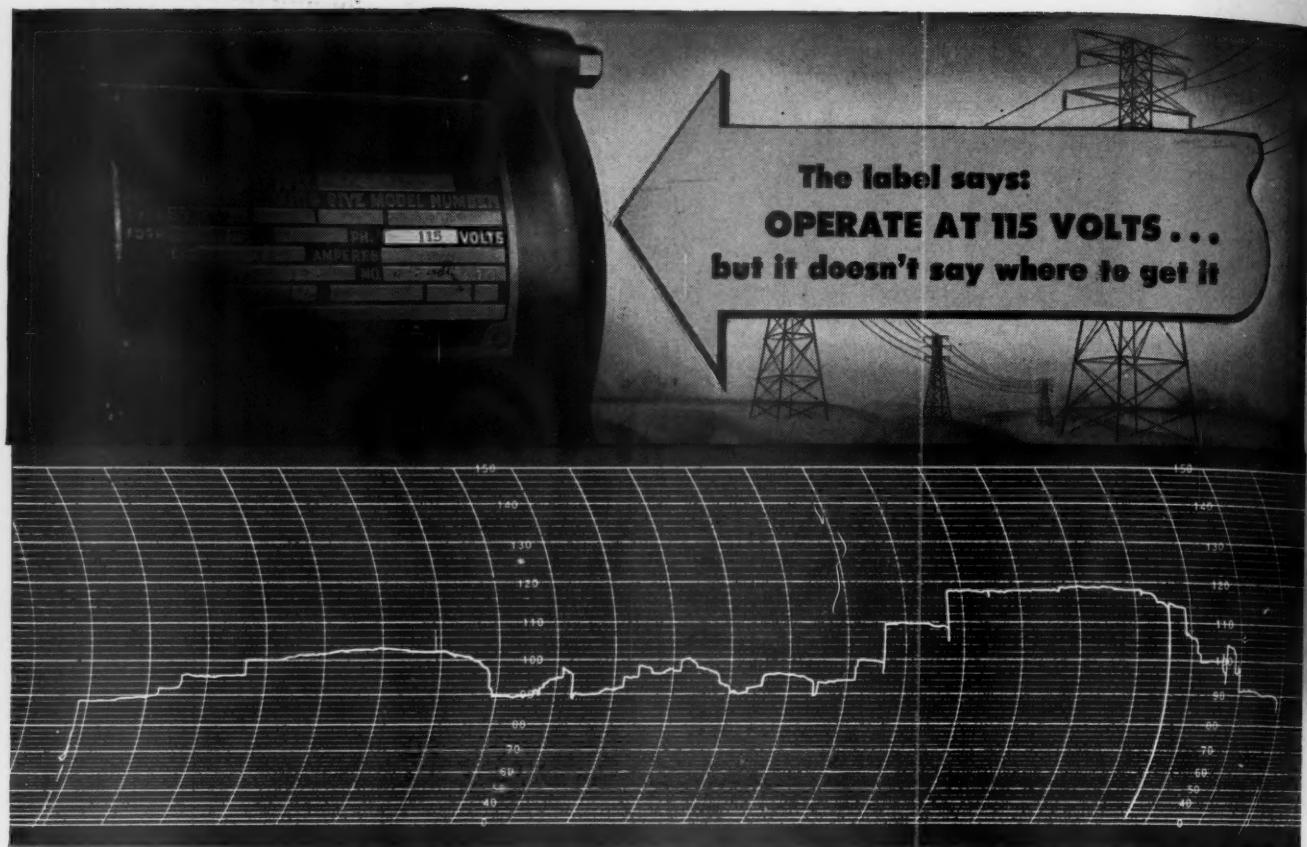
This electronic test of insulation makes a "cardiogram" of every Tri-Clad motor winding, ferreting out weaknesses that might lead to shorts caused by voltage surges in service. It tests each turn, coil, and phase group of the windings for adequate insulation strength to withstand the "steep front" high-voltage surges of actual service. First developed and applied by G.E., it's one of the production tests which all Tri-Clad motors must pass as they come off our production lines. — General Electric Company, Schenectady, N. Y.



GENERAL  **ELECTRIC**

TRI-CLAD
REG. U. S. PAT. OFF.
MOTORS

Each week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.



RATED VOLTAGE is always available to equipment protected with built-in CONSTANT VOLTAGE

"Operate at 115 volts" on the label of electrically operated precision equipment is not simply informative — it's a warning!

A warning that the device is too sensitive to tolerate the voltage fluctuations that may be met on America's power lines, and still perform with efficiency. A warning that sensitive tubes and other delicate mechanisms may be irreparably damaged by line surges and that costly replacements, with consequent loss of time and efficiency, lie ahead.

The design engineer who assumes that the precisely controlled voltages of the research laboratory will be duplicated in the field is heading his product toward trouble. Nominal

line voltage ratings can no longer be used as single, stable reference points for design considerations. Commercial power lines are too heavily loaded and unpredictable.

"Operate at 115 volts" is no longer sufficient on a label. A guarantee that the "115 volts" will always be available, in spite of the unpredictable fluctuations of commercial power, is a prime requisite if the device is to perform with unfailing efficiency and precision.

The place to provide voltage control is within the equipment. With a Constant Voltage Transformer as a component part, the device is provided with a dependable source of voltage and unfailing protection

against performance interference and construction damage.

SOLA Constant Voltage Transformers are available in sizes and capacities to meet design requirements of any electrically operated equipment or electronic device. Items so protected will deliver as efficiently in the field as under the most ideal laboratory conditions.

SOLA Constant Voltage Transformers have no moving parts to get out of order. There are no manual adjustments to be made. They perform instantly and automatically, maintaining output constant to within $\pm 1\%$ of the rated voltage, regardless of line fluctuations as great as 30%.

SOLA

Constant Voltage Transformers

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs
Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.

To Manufacturers:

Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.

Ask for Bulletin JCV-74



Heartbreak house or a real home?

YOU AND YOUR WIFE know just the house you want to build. She has good taste... and you're darned practical. Both of you envision your dream home... the most important investment of your life.



She has good taste and you're practical... yet you wind up with a white elephant, a heartbreak house. Drafty rooms... noisy plumbing... damp basement... tiny closets... inadequate hot water—minating to live with—costly to correct.

Can all that be avoided?

Yes... with an architect. Not only does he prevent disappointments but his skillful planning gives full realization to your hopes... a real home!

The architect's ability to coordinate house and lot, his experience with materials and builders, his training and foresight—all assure lasting beauty of design, fair resale value, low maintenance cost.

Imagine building a school or a skyscraper without an Architect-Engineer! Make sure your house is attractive and livable—protect your investment with an architect.

Plan your home now!
**START RIGHT—
WITH AN
ARCHITECT**

EDWARDS
SINCE 1872
ELECTRICAL SIGNALING
Bells • Chimes • Telephones • Alarms
for Homes, Offices, Schools, Hospitals

FREE . . . GET THIS NEW ILLUSTRATED BOOK!

EDWARDS AND COMPANY, NORWALK, CONN.

Please send copy of book "How to Plan Your New Home."

Name _____

Street _____

City _____ State _____

(Save Postage—Paste Coupon on Penny Post Card)



Electrical Contracting, April 1944

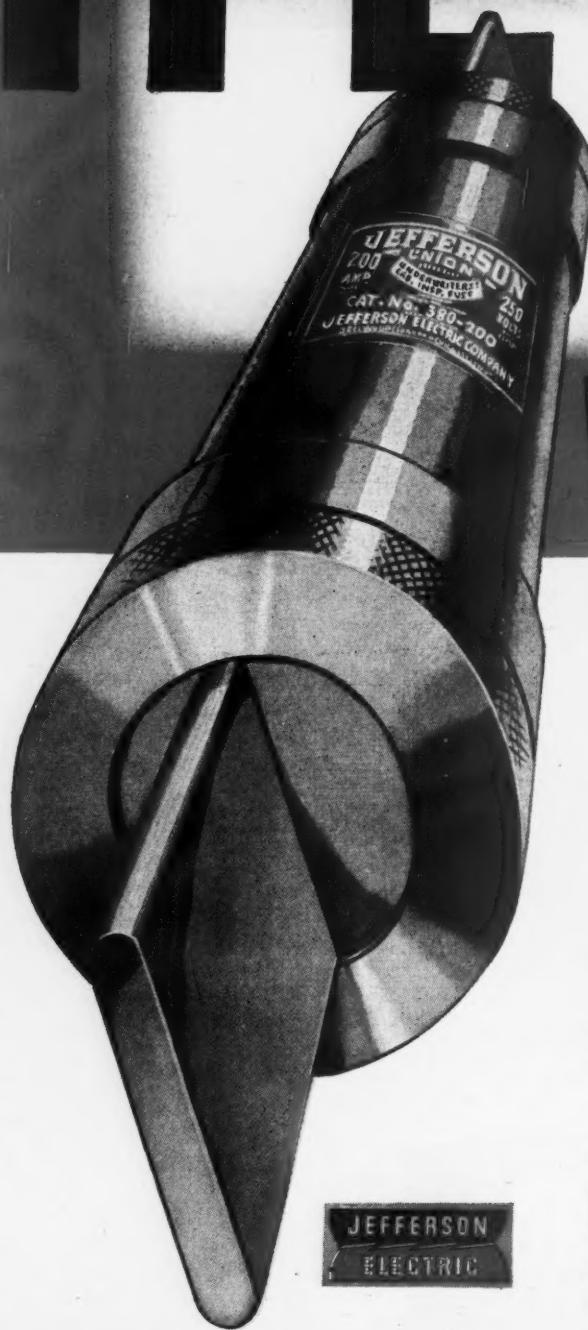
YOUR MARKET
WILL BE
IN THE
HOMES
THEY'LL
BUILD

Please read this Edwards' ad (shown at the left). It's one of a series in TIME and AMERICAN HOME magazines.

Where do you fit into this picture? How does this advertising affect you? All indications point to the greatest postwar building period this country has ever known. The amazing response from home planners to this advertising confirms this fact in a spectacular way. But it's our aim to prove to prospective home builders it pays to "Start Right with an Architect."

Selling the architect to the public means better building. Better building means more and better wiring and electrical equipment. This advertising educates the public... creates good will of the architect... and helps to build a more profitable postwar market for you.

**Edwards and Company
NORWALK, CONN.**



JEFFERSON
UNION
FUSES

A Good Renewable Fuse Must Withstand This

What a demonstration of fuse construction achievement is emphasized every time a fuse "blows".

An inferno of heat inside the fuse transforms the strip of cold fuse metal to a gas. Heat and pressure have dealt the fuse casing a shocking blow,—a blow good renewable type fuses must withstand.

To be sure of the full value and economy of renewable type fuses it will pay you to specify Jefferson-Union Fuses. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. Canadian Factory: 60-64 Osler Ave., W. Toronto, Ont.

JEFFERSON UNION

RENEWABLE FUSES

In a
nut-
shell..

There's a
Guth FLUORESCENT FIXTURE
for Every Fluorescent Lighting Need!

GUTH ARISTOLITE

GUTH LIGHTRONICS

GUTH FUTURLITER

GUTH EXCELUX

GUTH SUPER-ILLUMINATOR

Important
Guth High-Bays of Aluminum
NOW AVAILABLE!

Genuine Pre-War Models of GUTH High-Bays are ready now for shipment on A-1-J priority or higher! This prompt availability is the result of - 1) Special Government authorization; 2) Our own Aluminum already on-hand; 3) our Alzak Department in steady operation. Remember, it's PATRIOTIC to install the longest-lasting, best-performing High-Bays. Push GUTH High-Bays hard! Write for Folder 760—just published.

- The amazing completeness of the GUTH Fluorescent Line assures you, and your customers, of your unfailing ability to meet every modern lighting need. Write or wire today for Representative to call with actual Samples.

Ultra-Violet
FOR SCHOOLS • HOSPITALS • OFFICES

GUTH Germicidal Fixtures, which destroy air-carried bacteria and help control contagion, provide you a new, fertile field for sales and profits. Full engineering data, layout tables, advertising stuffers, and a new GUTH Germicidal line are ready NOW. Get full details NOW!

The Edwin F. Guth Co. • 2615 Washington Ave. • St. Louis 3, Missouri

Guth

Why is Jones better than Smith?

ON YOUR POSTWAR PAYROLL will be two men—let's call them Tom Jones and Fred Smith. They will do identical work. They will receive identical pay. Yet Jones will be better than Smith—produce better, faster, at lower cost. Why? Because Smith is "weather-sensitive". Summer heat and humidity slow him up. Industry knows the answer—and so do you. It's comfort air conditioning—and the figures are available on what it promises for lower postwar costs. Don't dismiss it as a fad. Your competitors aren't. Talk to the man in your town who is ready to help you plan for it now.



HOW YOUR LIGHTING COMPANY CAN HELP YOU CUT POSTWAR COSTS

Right in your city is an engineer-representative of your local utility who has the facts on comfort air conditioning . . . who can help you plan now to make all your employees produce to Tom Jones' level!

Postwar employee relations as well as post-war profits hang in the balance! For air conditioning can influence both—and it is not too early today to find out what it can do for your particular plant—and get it on paper!

Of course your electric company has something to sell. And so has Roebling. When the day comes that electric power takes over the job of filling your plant with year-round, high-efficiency climate, remember Roebling as wire specialists who are a logical source of supply for the wires and cables modernization will call for. For air conditioning. Better lighting. Better power distribution to your plant's work. Full utilization of all of the electric and electronic cost-cutters the war has evolved.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities



ROEBLING
PACEMAKER IN WIRE PRODUCTS

Wire Rope and Strand • Fittings • Cold Rolled Strip • Aircord, Swaged Terminals and Assemblies • Round and Shaped Wire
Wire Cloth and Netting • High and Low Carbon Acid and Basic Open Hearth Steels
Suspension Bridges and Cables* • Electrical Wires and Cables • Aerial Wire-Rope Systems

REMINDING INDUSTRY of the advantages of Post-war Electrical Modernization—with Better Lighting, Air Conditioning, Full Utilization of war-developed Electrical and Electronic Devices . . . this Roebling Campaign will aid Electrical Contractors.

Each Roll of
PANTHER and DRAGON TAPE
Contains Guaranteed Footage



Because of manufacturing tolerances, slight variations in weight may occur in any roll of tape. With **PANTHER** and **DRAGON** Tapes *this does not affect the footage*, which is actually measured as the tape is wound on the roll.

Whether or not tape is sold by the roll, or by the pound, is unimportant so long as the unit purchased contains a specific and guaranteed number of feet — sufficient to provide a given amount of "coverage"—and meets the requirements of the industry's specifications.

In addition, the dealer and his customer want quality. You can be certain of this with **PANTHER** and **DRAGON** Tapes because they meet the quality requirements of the latest U. S. Navy and Federal specifications.

HAZARD INSULATED WIRE WORKS

Division of the Okonite Company

Wilkes-Barre, Pennsylvania • Offices in Principal Cities



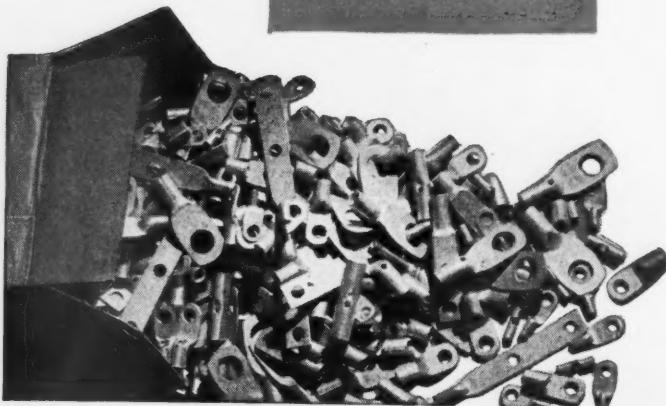
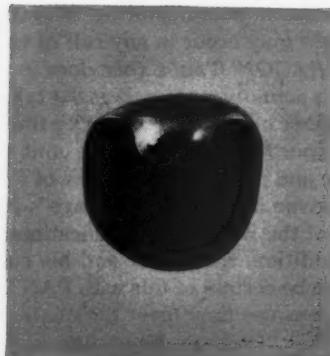
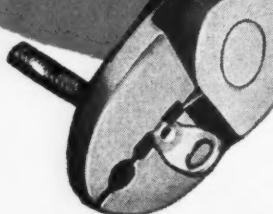
PANTHER and DRAGON

Friction and Rubber Tapes

"BUY U. S. WAR BONDS... Every Payday All Hazard Employees BUY U. S. WAR BONDS"



The Tool you'll soon connect with!



T

he torch bows out. Today, small wires are terminated or linked together simply by *Indenting* the connector to the wire with the Burndy HYTOOL. Speedy and simple . . . for no torch, no fuel, no acid are necessary.

But the big feature is that simple Indenting eliminates faulty connections. Note the cross-sectional view at the left . . . showing how connector and conductor have been permanently joined by indenting with the HYTOOL. *The connection is on to stay!*

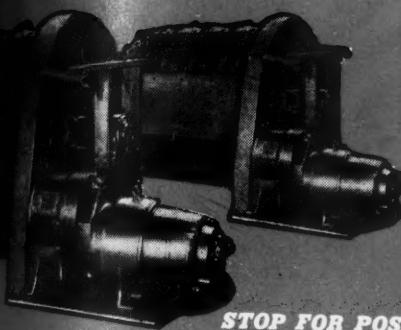
It's a better electrical conductor, too; since the Burndy HYDENT connectors used are of one-piece, pure copper construction. *No seams or joints to loosen, or increase resistance!*

Why not have the complete story on this modern connecting method at your fingertips. The Burndy HYDENT Catalog, available on request, gives complete details.

Burndy

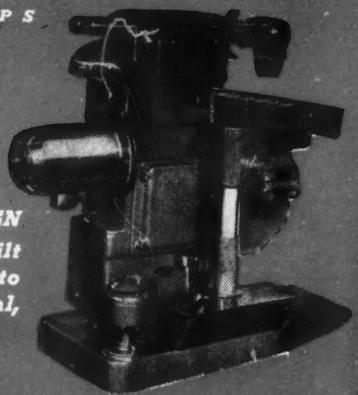
BURNDY ENGINEERING CO., INC.
107 EASTERN BOULEVARD, NEW YORK 54, N.Y.
IN CANADA: Canadian Line Materials, Limited, 13

BUY UNITED STATES WAR BONDS AND STAMPS



SIMPLE COMPACT DESIGN

The electric brake is built into the motor end cover to form a compact, economical, easy to use unit.



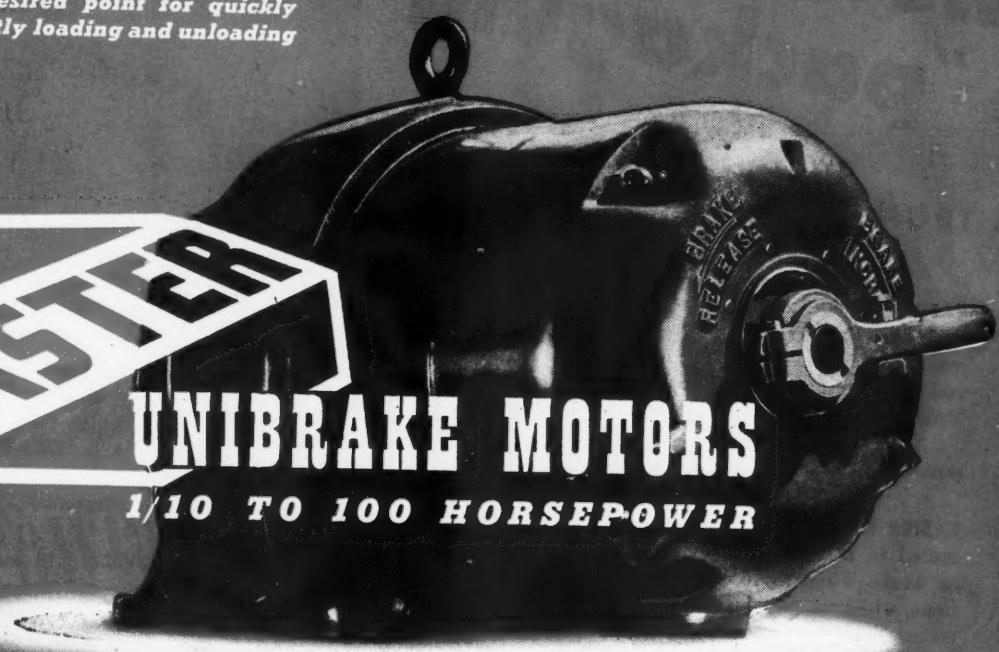
STOP FOR POSITION

Stop at the desired point for quickly and conveniently loading and unloading

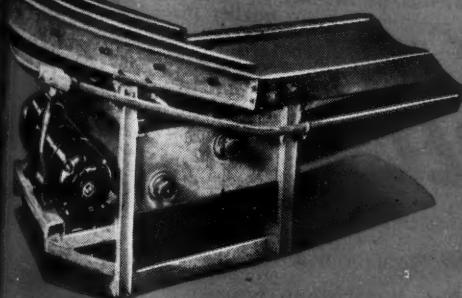
MASTER

UNIBRAKE MOTORS

1/10 TO 100 HORSEPOWER



THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

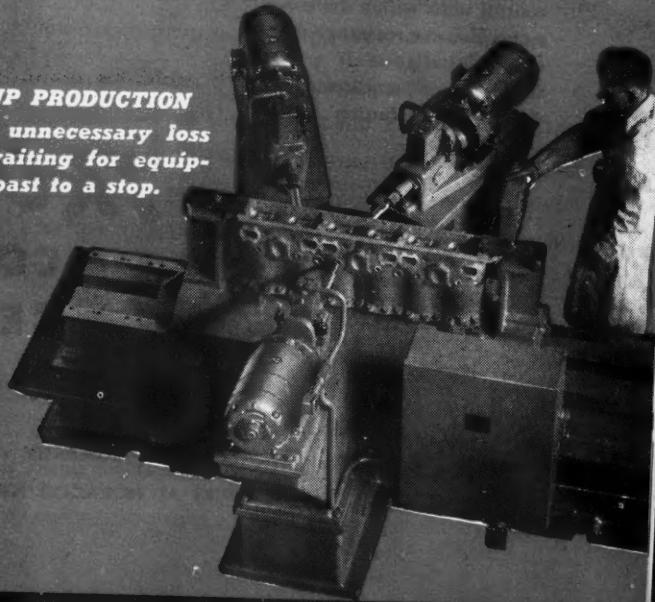


STOP AND HOLD ANY LOAD

Unibrake motors are very advantageous on hoists, elevators, inclined conveyors, etc....

SPEED UP PRODUCTION

Eliminate unnecessary loss of time waiting for equipment to coast to a stop.



modern "packaging"

in TRUMBULL CONTROL CENTERS

★ **EASIER to BUY** in "modern" packages. This is the NEW and better way to buy electrical control equipment. You order standardized stock units where once you had the expense and delay of "special engineering". You get exactly what you want for the job to be done . . . PLUS unlimited flexibility in planning for future extensions or changes.

★ **EASIER to install.** Trumbull Control Centers can be installed in *hours* where old time installation took days or weeks. First, the prefabricated bus bar vertical sections, which carry power, are lined up and connected to mains. Then the necessary combinations of control units are simply "plugged in" to the sections. That's all there is to it. Installation may be back-to-back or flat against walls because everything is accessible from the FRONT.

★ **EASIER to extend, rearrange or relocate.** Trumbull Control Center installations are as flexible in this respect as a "row of filing cabinets". You can add or remove sections; you can rearrange control units within the sections. You can rearrange the entire installation if your shop power requirements change in the future.



★ **EASIER to provide adequate protection against shutdowns** . . . first through centralized group control that assures a uniformly high standard of electrical safety for *all* equipment in a department. Secondly, by isolating one department or plant section from another as far as electric power is concerned.

★ **EASIER TO SERVICE.** All dead front construction . . . all units and entire mechanisms inspectable and removable *from front* . . . wiring connections easily made *from front*.

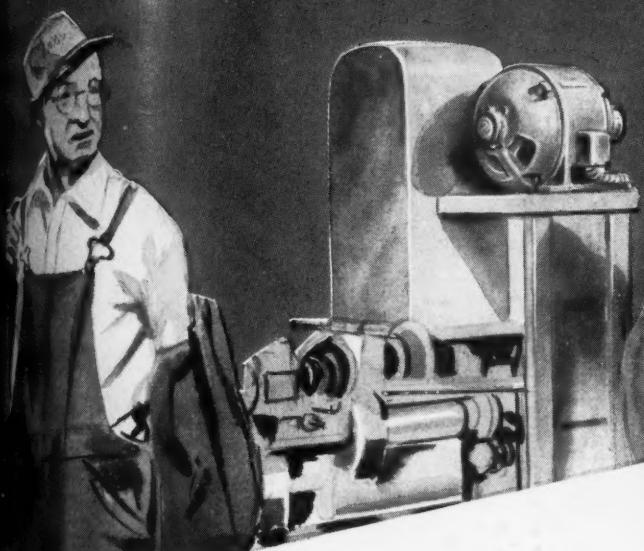
★ **EASIER TO LOOK AT.** Thin cross section, totally enclosed, beautifully finished in machine gray enamel, Trumbull Control Centers are the "show pieces" of most plants where they are installed. Good looks are important . . . and especially so when they are the result of correct design, expert construction and high quality throughout.

Write for Trumbullaid Bulletin No. 411.



THE TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION
OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES

SENT HOME...



BECAUSE OF A *Shoestring* Plant Power System

COULD IT HAPPEN IN YOUR PLANT TOMORROW MORNING?

- The sudden flash—the stalled machines—the catcalls of idle operators—the hurried conference at the desk of the maintenance chief—
- Then, the inevitable layoff—FOR PLANT POWER-SYSTEM REPAIRS!

Today, many otherwise well-equipped plants are "getting by on a shoestring" in transporting electric energy from the point of entrance to individual departments and machines. Weak spots in the system remain undisclosed, until suddenly something snaps! Then, repairs that take days to complete may be necessary.

If your plant power system has been adapted and extended to handle loads that it was not

originally designed to meet, it may now be partly or wholly a "shoestring" system: containing make-shift circuits; circuit breakers and fuses with inadequate interrupting capacity; long, overloaded feeders.

In addition to the outages you risk, such a system is often the overlooked cause of low production due to sluggish drives and poor lighting, and of high maintenance expense. Nurse it through for the time being if you must—but start planning now to replace it.

HERE'S *How* to plan for fully modern power distribution throughout your plant, using the G-E load-center system.

GENERAL ELECTRIC

shut-
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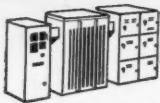
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NIZATION
April 194

BLOCKS of POWER*

right at each LOAD CENTER



* BLOCKS OF POWER

— — complete, compact, fully enclosed unit substations—are the basic elements of the G-E load-center distribution system for industrial plants.

In this system, plant power is distributed at high voltage to the substations, located at or near individual centers of power demand. Here it is transformed to a lower utilization

voltage and distributed over short, individually protected feeder circuits.

Thus, you avoid the high costs and voltage drop that result from use of long, heavy low-voltage feeders from a single, remote substation. You have a fully co-ordinated system throughout.

The best investment in the world is in this country's future. Buy War Bonds

GENERAL  ELECTRIC

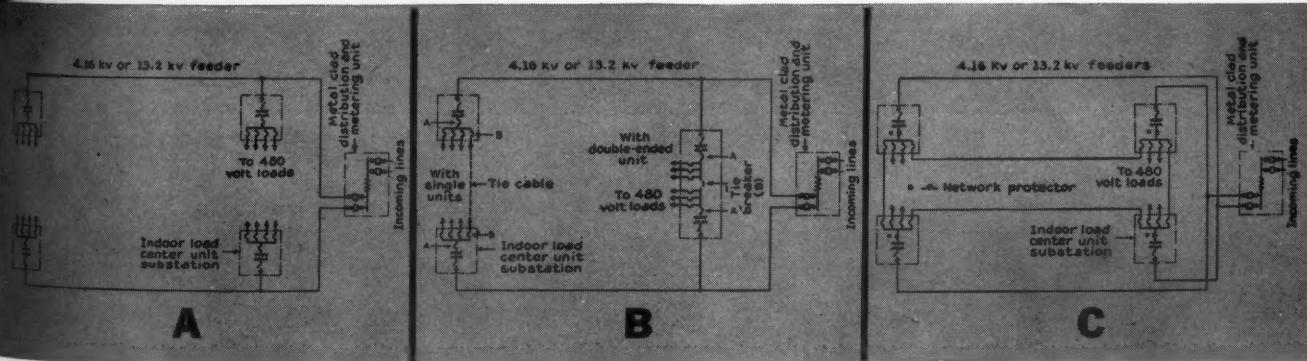
... safeguard your plant from CRIPPLING OUTAGES

The load-center distribution system—having G-E unit substations, and auxiliary equipment designed to tie-in with them—is the safe, modern way to guard against interruptions in power supply within your plant.

Even an inexpensive radial arrangement (see A below) is highly reliable when G-E unit substations are used, because the interrupting capacity of the switchgear is exactly matched with transformer capacity. *Self-protection* at each load center isolates most trouble within a single, short, low-voltage feeder circuit. And even when a primary circuit is opened at one substation, other load areas are not affected, and work can proceed as usual.

For still higher standards of service continuity, you can choose from a number of circuit arrangements such as the secondary selective (B) and the secondary network (C). The extra cost of this "service insurance" is far less than that of duplicate, long, low-voltage feeders from a single outdoor station.

Perhaps the biggest gain of all in avoiding power-system breakdowns comes from planning a co-ordinated system right from the start, using well-matched equipment of the proper capacity right where you want it. The load-center system permits you to make such a plan now, installing it complete, or block-by-block as a part of a gradual modernization project.



THE SIMPLE RADIAL arrangement consists of one or more load-center unit substations supplied by one primary feeder through one primary breaker. It is entirely adequate for the majority of installations. A radial circuit is low in cost and is extremely easy to operate. It offers a high degree of continuity when high-quality electric equipment is used throughout.

THE SECONDARY SELECTIVE arrangement uses duplicate primary feeders and transformers to supply each secondary load bus. Single-transformer unit substations are arranged in pairs (as shown at the left in the above diagram), or a double-transformer unit substation (as shown at the right) can be used.

THE SECONDARY NETWORK consists of two or more primary breakers and primary feeders, and two or more load-center unit substations, with the secondaries of the transformers operated in parallel through an inter-connecting grid. Automatic switching equipment disconnects a faulty transformer or primary feeder without any attention from an operator.

Get Started NOW for FUTURE PROTECTION ... Follow this Simple Plan

Plan Now for a Fresh Start in Plant Power Distribution

1 Begin with expected LOAD DENSITIES

Analyze today's power loads in terms of volt-amperes per square foot. Consider tomorrow's further electrification needs in each department.

2 Map out your LOAD-CENTER ZONES and FEEDERS

Subdivide floor areas in zones of 300 to 1000 kva, and determine the service continuity that each requires.

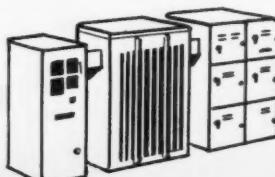
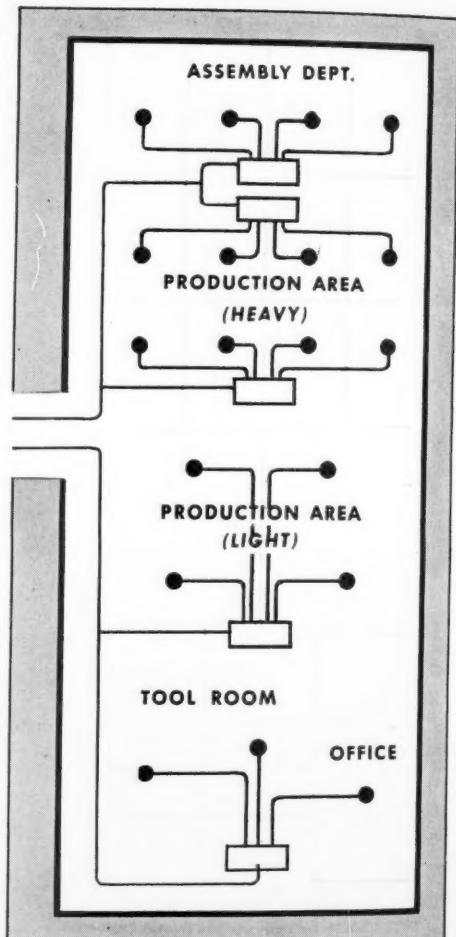
3 Work with G.E. on a "ONE-LINE DIAGRAM"

We'll sit down with you and your engineers to decide on the number and arrangement of unit substations, switchgear equipments, etc., and the interconnecting circuits you will ultimately want for a completely modern system.

**4 Be ready to order
STANDARD EQUIPMENT**

G-E load-center power distribution equipment is built up by block-assembly from standard, repetitively-built designs. Once your "one-line diagram" is complete, you can begin modernizing step by step at your necessity or convenience, using well-matched standard equipment.

For further information on G-E unit substations as applied in load-center distribution systems, write for Bulletin GED-1006. General Electric Company, Schenectady, N. Y.



GENERAL  **ELECTRIC**

THE SCENE: Lighting Conference

THE VOTE: MILLER Fluorescent—Unanimous

Lighting meetings like this have happened many times in the past in many a busy war plant—will happen many more times during crucial 1944. Inevitably the vote goes, hands down, to MILLER 50 & 100 FOOT CANDLERS, and here's why . . .

PLANT MANAGER—"We still have stiff production quotas to meet—with greener help. MILLER 50 & 100 FOOT CANDLERS will give us 30, 40, 50 or more foot candles of illumination—and that's what we need for better, faster production."

WORKER—"Sounds good to me. I've worked under MILLER fluorescent and I know I've worked better and felt

better simply because I could see what I was doing at all times clearly and sharply."

MAINTENANCE MAN—"Those light-weight Masonite reflectors MILLER uses will take plenty of punishment, and yet a girl can handle their cleaning. I like the exposed ballasts because they mean cooler operation. And I go big for that MILLER Patented Safety Lamp Lock that keeps lamps from falling."

ELECTRICAL CONTRACTOR—"I can handle the installation of MILLER equipment in less time, shorthanded as I am for trained help. Units go together easily into self-aligned runs. Hanging is simplified. I've had MILLER jobs result in installation savings of 30 to 50% to owners."

ARCHITECT—"I've specified MILLER Continuous Wireway Fluorescent Lighting Systems on both new construction and modernization projects. The beauty of it is its flexibility. Whole sections, or even the entire system can readily be moved to other parts of the plant."

UTILITY ENGINEER—"From power source right through to controls, the whole MILLER setup saves considerable critical material—and provides an adequate, modern lighting system . . . something we utility guys have been preaching for years."

OWNER—"You fellows hit both my pocketbook and my patriotism. I say let's specify MILLER 50 & 100 FOOT CANDLERS—and let's get a MILLER field man in pronto to talk turkey."



THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel





DO YO

al

Be

THREE are two kinds of fluorescent lighting in common use today—"Hot Cathode," the heater filament type, and "Cold Cathode," the improved shell electrode type.

Zeon Fluorescent Lighting is the outstanding example of the Cold Cathode type . . . it produces a light source that unit for unit will deliver as much light *four to five times longer* than other fluorescent lamps. Burning hours in excess of 10,000 are not uncommon . . . exceptional life that means minimum tube replacements, fewer production hold-ups and the lowest possible man-hour replacement cost.

Instant starting is an important feature of Zeon, and in operation, light flow

is uninterrupted—a great advantage when flickering light has been the chief cause of eye strain. The fewer auxiliaries used, the simplified fixtures, ease of installation and minimum maintenance of Zeon, are additional features which wise buyers value in fluorescent lighting.

When considering a fluorescent installation look to Zeon Cold Cathode Fluorescent Lighting, a product of Federal Electric Company Inc., who for over fifteen years have been leaders in the development and use of gaseous discharge lamps. Capable, experienced Federal lighting engineers are available in many cities to consult with you on your lighting problem. Feel free to call on them.



LIGHTING DIVISION

FEDERAL ELECTRIC COMPANY, INC.

CHICAGO 19, ILLINOIS

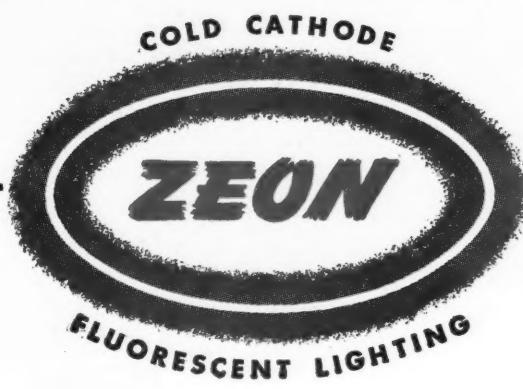
Branch Offices: New York, Philadelphia, Louisville, Cincinnati, New Orleans, Dallas, Houston, Indianapolis, Kansas City, Milwaukee, Minneapolis, Duluth. **Subsidiary Company,** Federal Brilliant Company, St. Louis, Mo.; **Associated Company,** Claude Neon Federal Company Southwest, Wichita, Kansas.

DO YOU NOW THAT

that Fluorescent Lighting is not alike?

Better Light

Longer Life



- LONGER LAMP LIFE
- LOWER MAINTENANCE COST
- INSTANT STARTING
- CONSTANT LIGHT FLOW

- LESS HEAT
- LESS GLARE
- FEWER AUXILIARIES
- GREATER FLEXIBILITY



Type GRF CONDULETS

(CONDULETS are manufactured only by CROUSE-HINDS)



Type GRF Condulet for Surface Mounting. With Mounting Feet.



Type GRF Condulet for Flush Mounting. With Slotted Holes for Nailing to Concrete Forms.

Adaptable — many uses. Takes blank or hub covers; terminal blocks; many Condulet accessories; standard 4" outlet box covers and wiring devices. Can be used as a

- Junction box Condulet
- Plug receptacle Condulet
- Lighting fixture Condulet
- Fixture hanger Condulet

Convertible. At any time after installation Type GRF Condulets can be quickly converted to other uses, as all equipment is interchangeable.

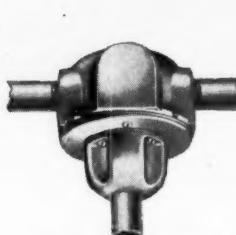
Cast Feraloy (semi-steel). Strong and rigid. Wide gasket surface for tight and weatherproof assemblies.

Bosses for drilling and tapping on sides and back. Will be furnished blank or factory tapped with tapered threads in any arrangement for $\frac{1}{2}$, $\frac{3}{4}$, or 1-inch conduit.

2 Styles. For flush or surface mounting.

3 Sizes. Inside depth, $1\frac{1}{2}$, $2\frac{1}{4}$, or 3 inches.

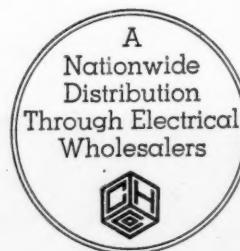
Listed in Condulet Catalog No. 2500, Section 15, Page 31.



Flexible Cushion
Fixture Hanger



Plug Receptacle



Ceiling Type Vaportight
Lighting Fixture

CROUSE-HINDS COMPANY
SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham—Boston—Chicago—Cincinnati—Cleveland—Dallas—Denver—Detroit—Houston—Indianapolis—Kansas City
Los Angeles—Milwaukee—Minneapolis—New York—Philadelphia—Pittsburgh—San Francisco—Seattle—St. Louis—Washington

Resident Product Engineers: Albany—Atlanta—Charlotte—New Orleans

CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant: TORONTO, ONT.

CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING • FLOODLIGHTS

"SWINGING BUS" proves highly satisfactory



Buses are 5" aluminum channels, held face to face by welded-on spacers.



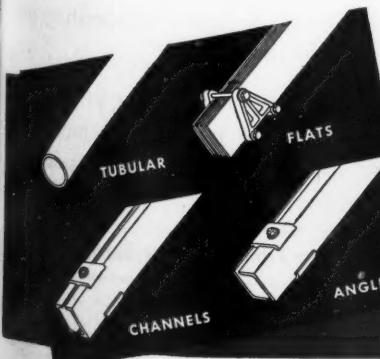
They're war workers, these Alcoa Aluminum buses, carrying power for vital production. Suspended from standard power-line insulators, with spans 24 feet rather than the usual 8 feet, costs were much lower than for rigid bus bar construction.

Buses are free to swing. The stiffness of the two Alcoa Aluminum channels comprising each conductor permits this long span design. The standard lengths supplied by Alcoa were welded

at the joints to make each run a solid unit. The aluminum supplies the high electrical conductivity required.

Alcoa bus bars, Aluminum Cable Steel Reinforced, and fittings are available for essential work. If your power project has been approved, Alcoa can supply the necessary materials. With them, of course, goes the usual Alcoa engineering advisory service. **ALUMINUM COMPANY OF AMERICA**, 1946 Gulf Building, Pittsburgh 19, Pa.

Note to manufacturers of electrical equipment: W.P.B. Order M-1-I now permits the use of aluminum for electrical conductors.



ALCOA

ALUMINUM

MOVE OR ADD LIGHTS

WITHOUT REWIRING-WITH UNIVERSAL Trol-E-Duct

4 BIG HELPS TO PRODUCTION

1 Puts Lights Where They Are Needed—Close to the Work

Universal Trol-E-Duct is a job-proven, modern refinement in factory lighting. Every inch of the duct is a potential electrical outlet which can be instantly tapped to put light close to the work. Simply move the light along the overhead duct, or plug in new lights wherever needed.

2 Always Ready for Quick Production Changes

Universal Trol-E-Duct, built in standard sections, is quickly and easily installed, and can be moved as easily to another location. It is an extremely flexible system — 100% salvable — always ready for quick production changes.

3 Fits Any Production Set-Up

It can be mounted against the ceiling or suspended by messenger cable below it. It will fit the layout of any industrial plant or commercial building.

4 Accommodates Any Type of Lighting Fixture

No matter what type of lighting fixture you use — fluorescent, mercury vapor, or incandescent — Universal Trol-E-Duct can accommodate it because every unit of the system is pre-fabricated at the factory for a wide variety of lighting fixtures.



BullDog's Universal Trol-E-Duct installation in a large midwestern machine tool plant. Note how the closely spaced fluorescent fixtures are suspended and tap current from the Trol-E-Duct runs.

Extreme Left — Shows how simply the trolley may be inserted at the end of the duct runs. Trolley entrance couplings also make possible insertion of trolleys between sections.

Immediate Left — The Twistout Plug can be used at any point in the duct run simply by inserting it in the duct slot and giving it a 90 degree turn.

BullDog Universal Trol-E-Duct is a lighting system of assembled standard duct sections, tightly and safely enclosing copper bus bars from which trolleys and twistout plugs collect current.

Thousands of war plants, big and small, find this thoroughly modern lighting system an important factor in speeding production by bringing light close to the work.

If conditions do not permit you to change over to this easy, quick, flexible lighting system now, be sure to modernize with Universal Trol-E-Duct before the products of peace go to market again.

Buy More War Bonds — Turn in Your Scrap



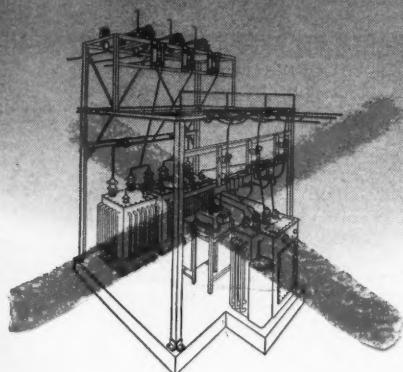
VACU-BREAK SAFETY SWITCHES • SAFTOFUSE PANELBOARDS • SWITCHBOARDS • CIRCUIT MASTER BREAKERS • DISTRIBUTION DUCT for "Plug-in" power • INDUSTRIAL TROL-E-DUCT, for movable "loads."

ALSO MANUFACTURERS OF



Westinghouse CSP Power Transformers contain in ONE UNIT:

- transformer • protection against
- circuit breaker —lightning
- voltage regulator —overloads
- metering —short circuits



NOT THIS ... piece-by-piece time-consuming removal and reassembly of the 43 major components of a conventional substation.

... when it's a Westinghouse CSP (Completely Self Protecting) Power Transformer

Because the Westinghouse CSP Power Transformer can be moved as a unit, it has 100% salvage value when moved to a new load center. It can be moved by truck-trailer quickly—in a matter of hours. Compare this to the time required to disassemble and move the conventional single-feeder substation. The CSP Power Transformer saves both material and man-hours . . . will cut considerably your postwar system reconversion cost.

While new postwar load centers may be unpredictable, it will pay to have substations which can be moved in to fill the gaps. The Westinghouse CSP Power Transformer performs all the functions of a single-feeder conventional substation. It is Completely Self Protecting (CSP) against lightning, short circuits, and dangerous overloads.

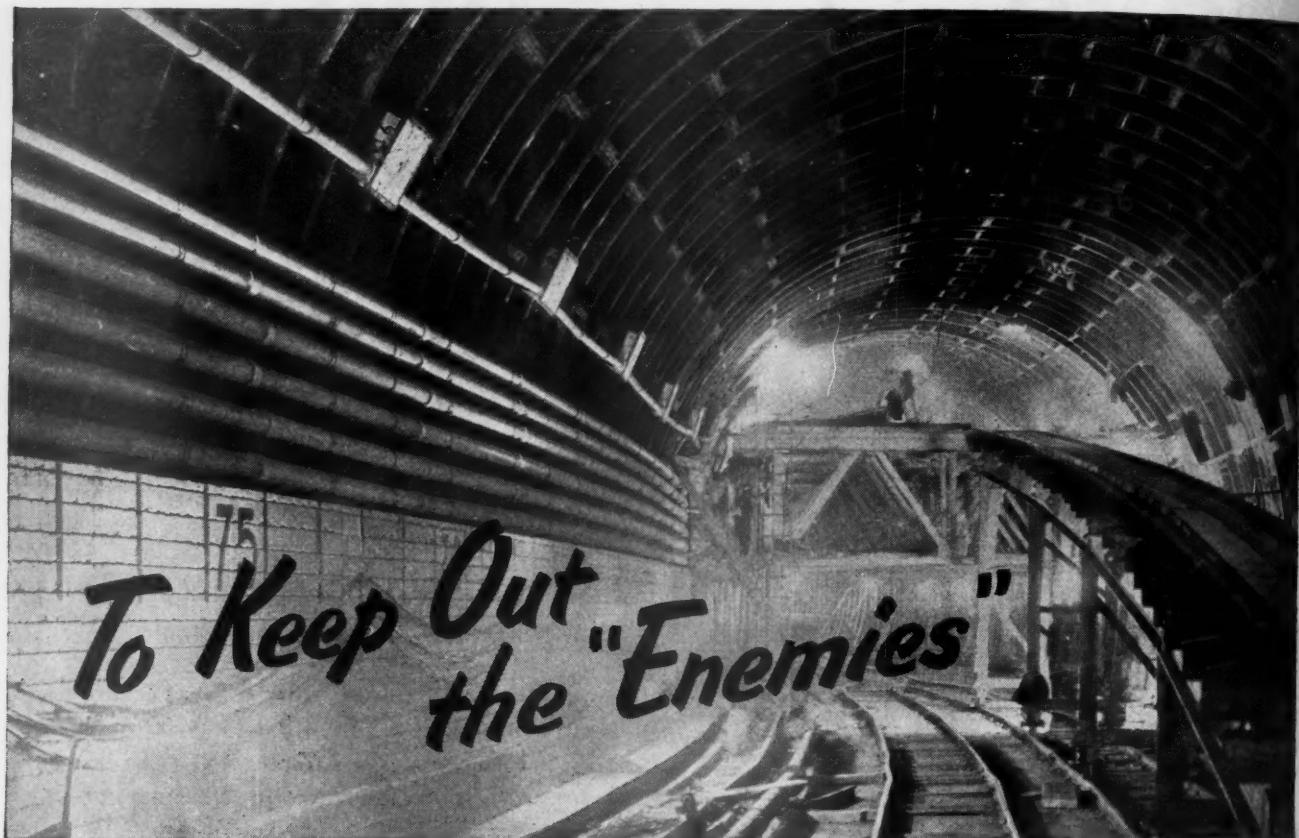
For complete information, call your Westinghouse office, or write Westinghouse Electric & Manufacturing Co., Dept. 7-N, East Pittsburgh, Pa. J-70429



Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

PACKAGED POWER

For SAFETY'S sake . . . use CONDUIT
(Full Weight Rigid Steel)



Rigid steel conduit afforded the only practical means of protecting vital electrical systems, both during construction and afterwards in this under-river tunnel.

WATER, moisture, vapors, dust and dirt may be persistent, ever dangerous enemies of even your finest wiring jobs.

The only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof for use in hazardous locations and occupancies is a standard-threaded rigid conduit.

For the duration, you may have to be satisfied with emergency wiring

methods and substitute materials. But you can start planning now for the day not too far ahead, when full-weight rigid steel conduit will be available again, and your distributor can furnish you the always reliable YOUNGSTOWN BUCKEYE CONDUIT you want.

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN 1, OHIO

Manufacturers of
CARBON, ALLOY AND YOLOY STEELS

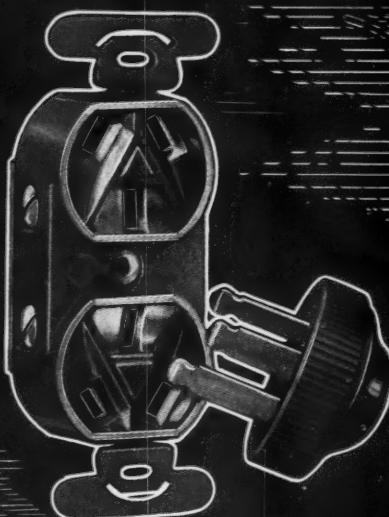
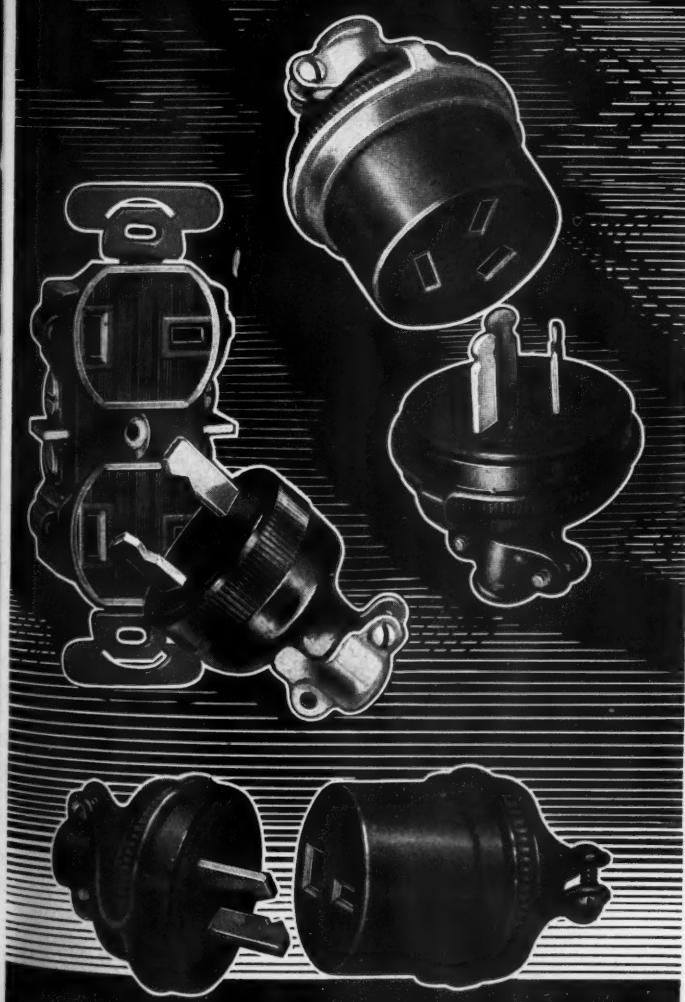


POLARIZED

ARROW

RECEPTACLES

PLUGS and CONNECTORS



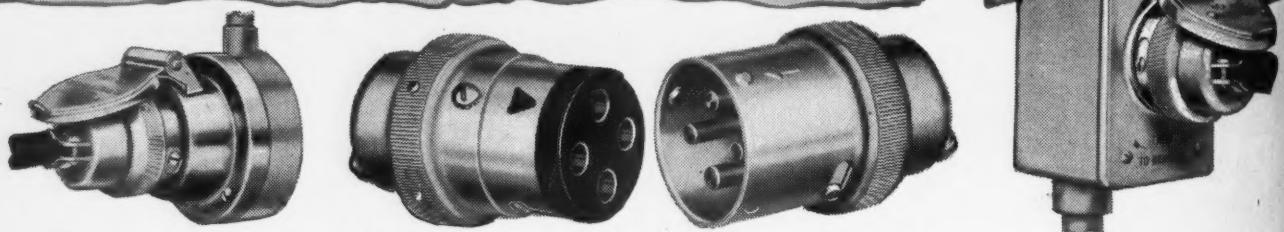
Give the workers in war-driven plants a wider range of usefulness. Extend the *reach* of their power tools. Install more *OUTLETS* for handy connections with portable drills, grinders, riveters, saws, melting pots, light machines — in just the locations to speed up production or assembling.

These Polarized Receptacles, Plugs and Connectors dependably *energize* new operations for which present wiring facilities may be inadequate. The line includes two, three and four-wire devices in 10, 20, 30 and 50 Ampere capacity. Pictured here are a few of the more popular types, available on priorities. More specialized needs are provided for also in rugged, reliable constructions.

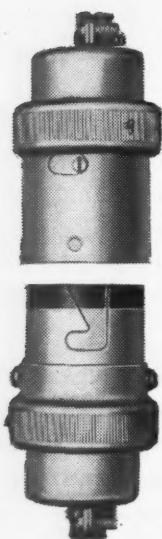
DISTRIBUTED THROUGH
ELECTRICAL WHOLESALERS

ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.



Automatic locking receptacles, plugs and cord connectors



You have seen the Ever-Lok many times and probably have used the "turn of the wrist" and heard the quick snap of the automatic locking device.

But do you realize that Ever-Lok is now available in a dozen different standard forms, that it can replace your present receptacles without new boxes and that it is a stock item readily obtainable through leading jobbers?

There is nothing complicated about Ever-Lok. Contacts are self aligning and provide positive grounding. It is impossible to connect up the wrong way. The all-steel casing is dustproof, corrosion resistant and rugged enough for the heaviest duty.

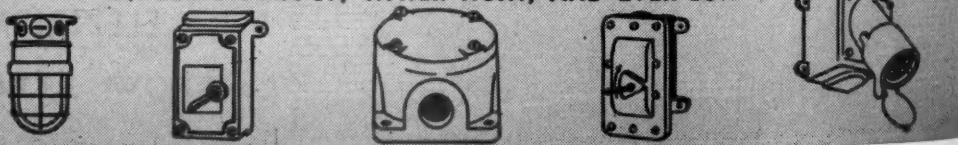
Ever-Loks are also made for conduit, outlet box, flush and floor mountings, for reverse—or multiple service and weathertight if desired. Ideal for portable equipment, test benches, outdoor applications such as communications and any service where interruptions must be avoided.

Manufacturers of portable electrical equipment can insure continuous service of their product by installing Ever-Lok as a part of the original equipment. Ask any electrical jobber or contractor.

RUSSELL & STOLL COMPANY

125 BARCLAY STREET • NEW YORK 7, N. Y.

EXPLOSION-PROOF, WATER-TIGHT, AND EVER-LOK



10



"Beefing" Won't Help! You need Horsepower by Howell

ELECTRICIAN: Boy, they're running me ragged. Motors coming in with no insulating varnish on 'em, and no phase insulation. Some of 'em out of balance. Doesn't take much to break those babies down.

HORSE: I know. That's why I want to tell you about Howell Motors.

ELECTRICIAN: Yeah! You better know what you're talkin' about.

HORSE: Every Howell Motor is thoroughly insulated. All our rotors are statically and dynamically balanced—they're precision-built, too.

ELECTRICIAN: Good! But do they stay that way?

HORSE: You bet they do! Good materials—copper rotors, high grade bronze or ball bearings—and careful workmanship insure long life. Ask the hundreds of Howell users in the automobile, ventilation and air conditioning industries, in dairies, grain elevators, shipyards, tank plants—they'll tell you . . . you can always depend on Howell Motors for longer, more dependable operation.

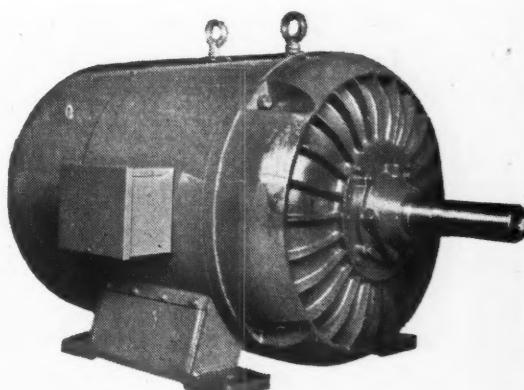
ELECTRICIAN: I know. I've used them. But we haven't got Howells here.

HORSE: Well, quit "beefing" and specify Horsepower by Howell for your next job.

For your specialized or standard motors, phone the nearest Howell representative today, or write the factory. Get the finest motors that money can buy at no premium in price.

HOWELL ELECTRIC MOTORS COMPANY
HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915



Howell Totally Enclosed, Fan-Cooled Motor (shown above). Available through 125 H.P. . . . all working parts are protected against dust, fumes or moisture . . . Fan cooling prevents undue temperature rise (motor overheating) . . . All steel, streamlined housing provides minimum weight and greater compactness of overall length . . . built to N.E.M.A. frame dimensions . . . special horizontal and vertical fan-cooled motors are available.

Also a wide range of other types of motors up to 150 H.P.



ECONOMY, CONVENIENCE, AND SPEED

are built directly, simply, and sturdily into SHAWMUT SHUR-LAG RENEWABLE FUSES and LINKS. You can replace the link in a SHUR-LAG fuse in a matter of seconds, and be in circuit again; and a SHUR-LAG fuse will give you full protection at all times. Use SHAWMUT SHUR-LAG RENEWABLE FUSES and LINKS, and get rid of fuse trouble for good, as so many others have. Our Bulletin 400 will tell you all about it.

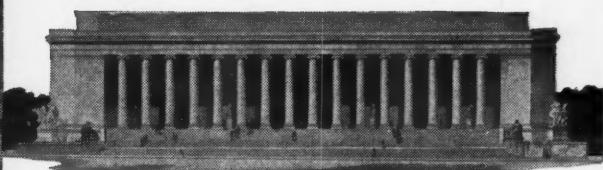


The Chase-Shawmut Company
Newburyport, Massachusetts

How Central Rigid Steel Conduit was used

in Mellon Institute

*Built for
Eternity*



"There's
Tested Strength
in Every Length"

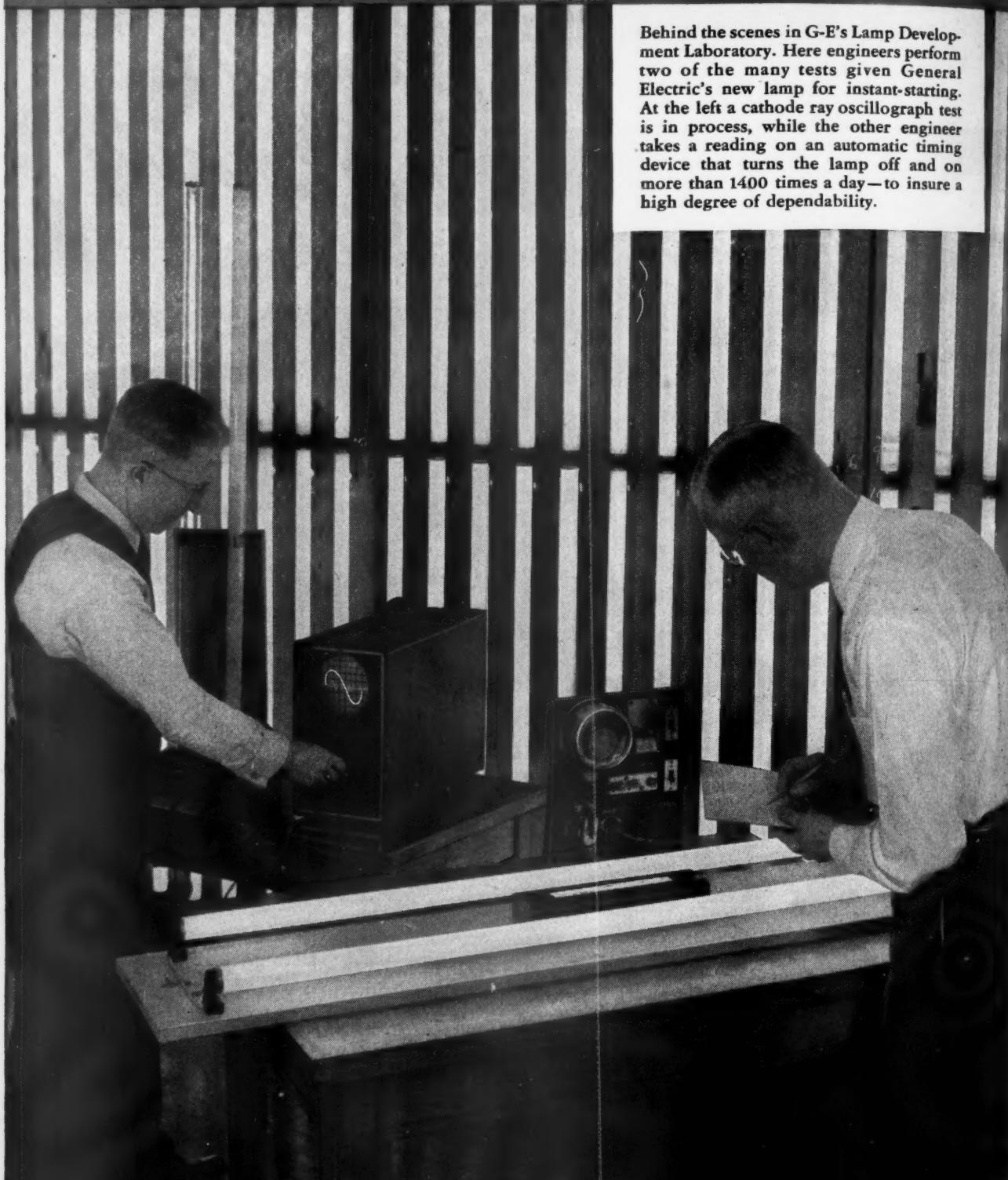
SPANG-CHALFANT

Division of The National Supply Company

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GENERAL ELECTRIC RESEARCH



Behind the scenes in G-E's Lamp Development Laboratory. Here engineers perform two of the many tests given General Electric's new lamp for instant-starting. At the left a cathode ray oscillosograph test is in process, while the other engineer takes a reading on an automatic timing device that turns the lamp off and on more than 1400 times a day—to insure a high degree of dependability.

GENERAL  ELECTRIC

DEVELOPS FLUORESCENT LAMP for INSTANT- STARTING!

New General Electric 40-watt Fluorescent Lamp Starts Instantly and Positively

Here is fluorescent lighting—at the flick of a switch! A fluorescent lamp that starts as instantaneously as an incandescent lamp!

General Electric soon will make available a 40-watt white G-E Mazda fluorescent lamp for operation with instant-starting ballasts. Shipments in limited quantities will start May 1st. New General Electric instant-starting ballasts will be made available at the same time by G-E's Transformer Section in Ft. Wayne.

Instant-starting can be obtained with regular fluorescent lamps when used with an instant-starting ballast, but only at the cost of a substantial reduction in lamp life. The new 40-watt G-E fluorescent lamp operates on instant-starting ballasts *without sacrifice of*

rated lamp life. It will sell for the same price as regular 40-watt G-E Mazda fluorescent lamps.

The new lamp, operating with a high voltage instant-starting ballast, eliminates the need for conventional starters. However, under abnormal operating conditions, such as high humidity, special provision may be needed to assure starting.

Another Example of G-E Leadership in Lighting

The development of the new fluorescent lamp for instant-starting is just one more example of the never-ending lighting progress led by General Electric lamp research. Through this research is assured the uniform quality and dependability that are characteristic of the complete line of General Electric Mazda lamps.

G-E High Voltage Ballast for Instant-Starting



Latest development in the G-E Specialty Transformer laboratories at Fort Wayne is the new type ballast for use with instant-starting fluorescent lamps. Available in limited quantities about May 1st in four voltages with end out or base out leads. Rated life of the new fluorescent lamps when used with these ballasts is the same as that of regular G-E Mazda F lamps using the conventional switch and starter.

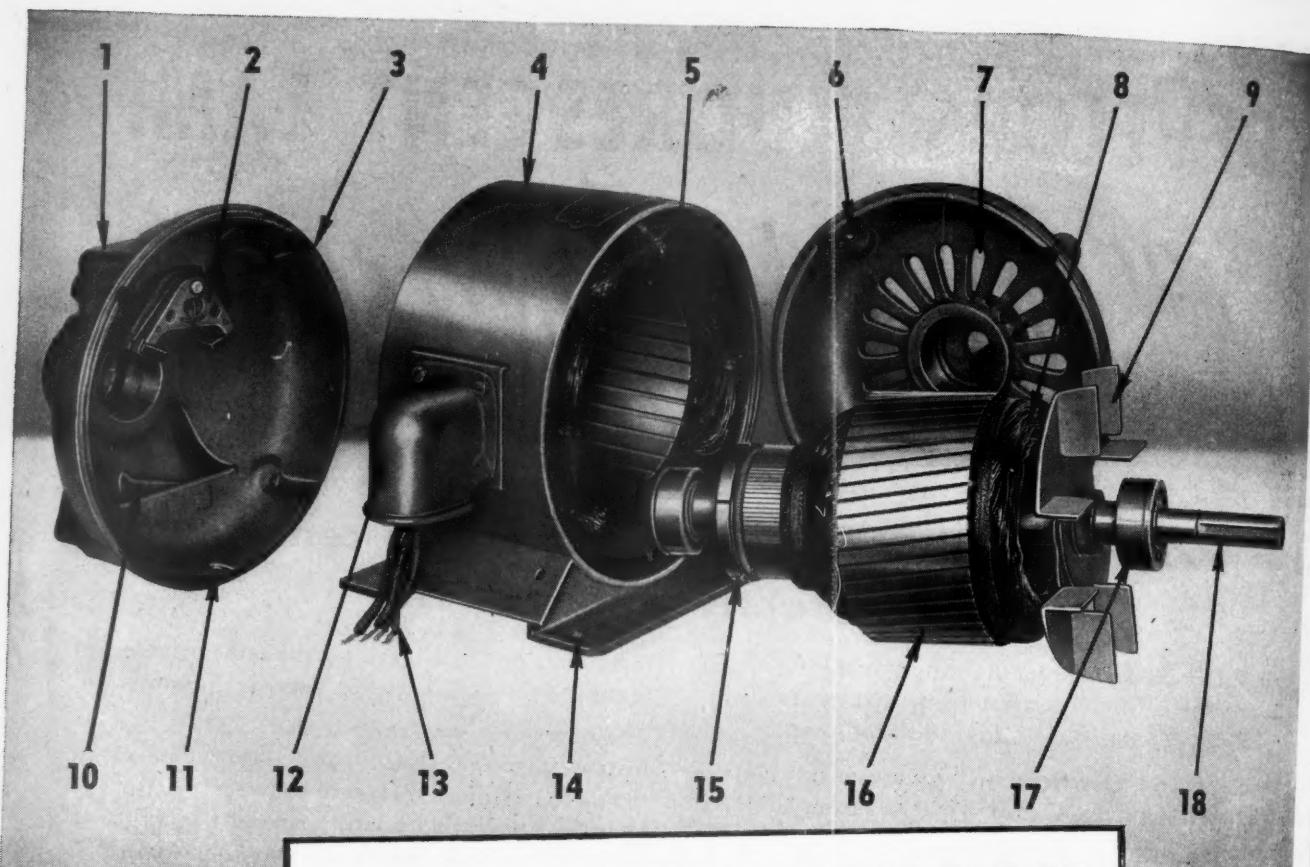
Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday 10 p. m. EWT, NBC; "The World Today" news, every weekday 6:45 p. m. EWT, CBS.

THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE
—BUY WAR BONDS

"TO MAKE LAMPS
STAY BRIGHTER LONGER"
The Creed of G-E RESEARCH



G-E MAZDA LAMPS



HOW IT WILL PAY YOU TO GIVE THIS R&M *Uni-Shell* MOTOR THE "ONCE-OVER" 18 TIMES!

- (1) Removable insulation and inspection openings.
- (2) Brush lifting mechanism removes the brushes about two-thirds proven in practice.
- (3) Cast iron head which fits for good operation. Machined.
- (4) All-steel body with field bore assuring alignment.
- (5) Stator winding with materials and protection thru the use of symmetrical slots.
- (6) Shoulder for long life. These studs are so designed that the heads can be countersunk for ceiling or ball bearing design.
- (7) Small ventilating slot for ventilation. This slot is secured against foreign material by the motor and against the fan.
- (8) The armature winding with insulating material in the form of a layer type winding.
- (9) Steel fan as used on

Page 17 of the new, 20-page R & M Uni-Shell Motor booklet lists 18 points on the R & M Single-Phase Induction Motor that it will pay you to check. See how you benefit from practical design and carefully correct construction.

Learn how newer insulating materials give you extra protection against breakdowns . . . how adequate ventilation assures low-temperature, long-life operation . . . how sure safety engineering guards against entry of foreign materials and personnel injury . . . how Uni-Shell mounting interchangeability permits you to switch motors quickly and easily.

Ask for your free copy of the Uni-Shell Motor booklet on the handy coupon, now.

ROBBINS & MYERS • INC.
MOTOR DIVISION, SPRINGFIELD, OHIO

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Please send my free copy of the new, informative Uni-Shell Motor booklet.

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I would would not like to talk to a representative.

Disposal of Government War Plants and Equipment

In the last four years, the Federal Government has spent over fifteen billion dollars on war plants—two-and-one-half times as much as was spent by private investors.

Of this fifteen-billion-dollar government investment, about one-third has gone into facilities for the manufacture of aircraft and for ship construction and repair; another third has gone into plants for production of combat ordnance; and the remaining third has gone into a variety of facilities for making synthetic rubber, metal products, machinery, and miscellaneous equipment.

Most of these plants are in industries that are expanded far beyond peacetime requirements. Furthermore, their convertibility to other civilian uses will, in many cases, be complicated by their specialized equipment and layout, by their tremendous size, and by their uneconomic location. At the moment, it looks as if roughly one-third of the government-owned plants and equipment can be converted fairly readily to peacetime operation, and will, therefore, be easily disposable to private enterprise.

The discovery of unsuspected uses for war plants and equipment may well raise the disposable proportion to one-half or more. The government, at the end of the war, may own about one-eighth of the commercially-useable industrial capacity of the country. It will be by far the largest owner of machine tools; it will own enormous aluminum capacity, magnesium capacity, many miles of pipe lines, and more ships than the entire private shipping industry.

What the government does with its war plants will have a profound effect on the free enterprise system and on all workers, employers, investors, and consumers who have a part in that system. If this problem is handled badly, we may find ourselves enmeshed in a trend toward monopoly and government operation of industry. If the problem is handled well, we shall have taken a big step toward freedom of action in a competitive society, toward full opportunities for business enterprise, toward well-paid productive jobs for workers, and toward a higher standard of living for us all.

Recently, three important events have signalled encouragement. They are the report of Senator George's Committee, the Baruch report, and the report of Senator Truman's Committee. These reports are noteworthy for their competent sizing up of a complex problem, for their recognition of the major responsibility of government in making a successful transition to peace, for their insistence on wise policy and good administration, and for their genuine concern that our productive powers be given full opportunity in a free private enterprise system. These reports agree on basic principles and many specific lines of action. There are, however,

important areas of policy formation, organization, and procedure--especially in regard to plant disposal—which remain to be blue-printed.

In formulating the policies and practices to be followed in dealing with government war plants, our major goal must, of course, be a high level of production and employment in private business after the war.

Government operation in competition with private employers and privately-employed workers will not be desirable because it will make investment unattractive to private capital and will limit opportunities for private employment. On the other hand, sales to private buyers which result in increasing the concentration of industry will also be undesirable. We must use this opportunity to strengthen the competitive enterprise system and to move away from, not toward, the concentration of economic power in either public or private agencies.

To accomplish these objectives, a program of action such as follows will be necessary:

1. An adequate reconversion organization will be needed in the government, but its powers and responsibilities should carefully be defined by Congress. Fortunately, an able Administrator of Surplus War Property already has been appointed. It will be essential for him to work in closest cooperation with Congress and with the Armed Forces and other executive agencies. The Office of War Mobilization, and ultimately the President, must be responsible for seeing that the Surplus War Property Administration is not sidetracked by the operating agencies and is not dominated by their sheer size. Funds must be supplied generously to the Surplus War Property Administrator, so that he can set up an organization adequate to cope with this huge and complex job. Business, too, must be generous in loaning top-flight executives for postwar government service.

2. One of the first acts of the Surplus War Property Administration will have to be to assemble a complete inventory of government war plants and equipment, to make possible the planning and control of the disposal process, and to form the basis of catalogues of property available for sale.

3. Cooperation between the executive and legislative branches of the government will be needed to develop at least tentative plans with respect to matters of public policy which are of special importance to a successful transition to peace. Among these matters are the size of the military establishment to be maintained in time of peace, the stand-by facilities and reserves of materiel necessary for our security in case of future war, and our policy regarding import and production of synthetic rubber and other critical and strategic materials.

4. The Surplus War Property Administrator should

obtain from the Armed Forces, acting under congressional directives, specification of those plants which are needed to supply our peacetime Army and Navy and to provide the essential reserve capacity in case of war.

5. The Surplus War Property Administrator should select certain war plants as depots in which to store the huge surpluses of inventories and equipment which will have to be removed from private and government-owned factories in order to make possible their conversion to civilian use.

6. Those plants which are not desired by the Army or the Navy, which are not needed for storage, and which clearly will be unsuitable for peacetime utilization should be scheduled for dismantling and disposal piecemeal.

7. The two or three billion dollars' worth of government facilities intermingled with private plant should receive attention with a view to early sale, temporary continuance or use under lease, or early removal.

8. The various plants and pieces of equipment available for sale to private business should be classified conveniently, catalogued, and advertised to prospective buyers or lessors. Before the Surplus War Property Administrator offers, for private sale, plants and equipment not desired by the Army or the Navy, he should ascertain whether the plants or equipment are desired by other branches of the government or by public corporations such as the T.V.A.

9. Whenever property can be sold at prices approximating depreciated reproduction cost, that will be by far the best solution. Generous time-payment terms should be offered. In many cases the government may be unable to sell the property for reproduction cost less depreciation, for the simple reason that no one would think of reproducing it. The property may already be partly obsolete or, because of its size, location, or other characteristics, may only be moderately well suited for commercial use. This should not prevent the government from selling it, provided a price which fairly represents the worth of the property can be obtained. The best test of that worth is the price produced by active bidding under favorable market conditions.

10. When property cannot be sold at a fair price, temporary leases with options to buy should be employed to get the facilities into productive use. This should not, however, be done on terms which would cause unfair competition or create clearly excessive capacity in an industry. And the lease must be temporary; it must not be the means to prolong government control or ownership.

11. The government should offer the strongest possible resistance to local groups or industry groups seeking subsidies for continued operation of war properties. Subsidies will burden the Treasury and lead to inefficient use of resources. They will be justified only to maintain facilities needed for national security.

12. The plants and equipment offered for sale and lease should include sufficient quantities in small enough lots to satisfy the demands from small business. The war

has tended to concentrate production in larger plants. After the war, we should seek a wider distribution of the government war facilities.

13. Insofar as possible, war buildings and equipment should be offered for sale in units which can be purchased by businesses in peacetime industries. Many of these industries have had to get along during the war without adequate replacement and expansion, and will be ready to buy if they are able to get what they want from the government. This is a particularly desirable market for surplus government property since these industries are, for the most part, not faced with the problems of excess capacity.

14. Property, such as machinery and other movable equipment, which is in excess of our domestic requirements or is more urgently needed by other countries, should be exported. We shall need, and can take, large supplies of raw materials in return.

15. Property which is not needed by the Armed Forces, which cannot be sold or leased on terms which would be fair to competing plants, which cannot be dismantled and distributed piecemeal, and which cannot be sold abroad, should be scrapped as soon as its non-disposability is apparent. The disposal of war plants should be completed within three to five years.

16. All negotiations for sale or disposal should be matters of open public record. As Mr. Baruch has said, the process must be conducted in a goldfish bowl. This is as much for the protection of business as for the protection of the government.

These courses of action do not include everything that must be done, but they do indicate the general lines along which our surplus war plant disposal must proceed if it is to avoid precipitating needless transition unemployment.

The gravest danger of all will be red tape, intergovernmental conflict, and inadequate administration. It would be a great misfortune for the executive and legislative branches to quarrel over details of organization when they agree on the basic principles to be followed in handling the problem. Obviously, the Surplus War Property Administration must cooperate with Congress and look to it for policy guidance. Just as obviously, the disposal problem will involve great difficulties of administration which must not be complicated by congressional interference. We shall need the best we can get in careful policy making, detailed planning, good organization, and courageous action. This is a matter of vital importance to every American. The stakes are too high to tolerate poor administration or petty politics.



President, McGraw-Hill Publishing Company, Inc.

IS YOUR BRAIN CHILD A PROBLEM CHILD?



**Take it up with
WALKER of CONSHOHOCKEN!**

Post-war developments may bring plenty of new and difficult problems in wire, cable or conduit. But don't worry—we can help you. Our long experience and our expanding research laboratory are at your service. If we don't have the answer, we'll soon find it.

"WALKER of Conshohocken" means Service. We invite your questions and your special problems. Write, wire or telephone to Walker of Conshohocken, Pa.

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**WIRE WITH
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Rubber-Covered, Synthetic and Leaded Wires and Cables

"Walkerflex" Non-Metallic Sheathed Cables

Service Entrance Cables

Automotive Wires and Cables

Shipboard Cables—Leaded, Non-leaded; Synthetic or Varnished Cambric Insulation

Electric Metallic Tubing

"Dualcote" Rigid Steel Conduit

"Preset-Inserts" Underfloor Distribution Systems

WALKER of Conshohocken

(Here's another ad in the series that brings a vital message to your customers.)

How many
"VICTORY" JOBS
will result from



increased use of

Electric Energy

It's an exciting postwar picture any way you figure it. Expanded use of electricity is one of the brightest fields to count on for jobs for our returning service men.

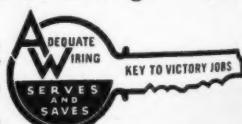
Think of the employment that will result from electronics alone, which includes radio, television and countless industrial and home applications. Or consider air conditioning, heating, cooking, lighting, refrigeration. As new and finer electrical products are developed, employment all along the line will be created . . . within the elec-

trical industry, and in every other industry.

But one thing is self-evident. Wiring will have to come first. Adequate wiring will be essential to full utilization of the electrical possibilities of the future. Now—in advance—is the time to plan for it. By all means, give it full weight in your postwar thinking.

Unwired planning will cost you a whole lot more than *planned wiring!* 44223

HELP BRING VICTORY SOONER . . . BUY MORE WAR BONDS.



ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

Electrical Wires and Cables of Copper are the Life Lines of our Nation

Electrical Contracting, April 1944

NATIONAL PERSPECTIVE

Men once built business careers on a local scale. The more successful ones gaged the business potential of the community. They sought opportunities for greater community service. They met the local competition. And they prospered.

Especially was this true of electrical contracting or motor repair. Labor problems were ironed out with the local union. Supply problems and price policies were argued with local wholesalers. The steady progress of the code structure was translated to meet local conditions and practices by the local inspector. And Washington was far off.

War has changed all that. Local problems, local plans, and local action are still the most important factor in individual business progress. But the welding of a national economy for war has broadened the scope of business responsibility. It has added a responsibility for national perspective to local operations. It has demanded of all business men a share of their energy and thought to the solution of industry problems on a nation-wide scale.

In our industry we have been fortunate in the quality of leadership that the National Electrical Contractors Association has brought to the wartime problems of the electrical contractor. And the active work of the National Industrial Service Association to coordinate the full strength of the motor shops to meet the

critical shortage of motors and the great increase in industrial service requirements is a proud record of national service.

Both of these important national groups will hold general meetings this month—important meetings. Both have continuing problems of keeping the maximum capacity of contractors and motor shops behind the war effort. There are still critical problems of manpower and materials, regulations and relations with labor and government that must be solved. And both organizations offer their members an all-important national perspective on local problems.

In the days ahead, through reconversion, through the opening of peacetime channels of commerce, the need for strong, active national association work will be even more urgent. Against inter-industry competition for markets and a share of the consumer's dollar—toward business development on a creative scale—toward making sound and secure jobs for returning service men—we shall need the best minds and the most sincere understanding of industry problems on a national scale that we can bring to bear. And national perspective throughout the membership will be just as vital as it is today.

Wm. J. Stuart

Electrical Contracting

APRIL, 1944

ANOTHER MESSAGE TO ARCHITECTS AND BUILDERS... *telling about Electrical Contractors*



work with a man who knows the neighborhood

New ways of doing things electrically will be featured in many post-war building developments. Community buildings, commercial buildings and homes may call for new wiring materials, new protective devices and new techniques of installation.

Full utilization of these electrical innovations, however, is not just an architectural problem. It calls for a realistic, fully-informed knowledge of local ordinances, conditions and understandings of electrical contractors "know the neighborhood" in every locality where they do business. They know the power-supply conditions, the code con-

ditions, the weather conditions, the labor conditions.

Before you decide on electrical building systems or equipment for post-war building plans, call the right kind of an electrical contractor. He'll be glad to work with you on industrial, commercial, or community buildings, even though your project is still tentative. All over the country, you'll find electrical contractors well qualified and well informed—the "John Watts" who do their electrical buying via GRAYBAR.

3518

Give Your Electrical Work to "John Watts"
a qualified electrical contractor heading a well-established firm with the trained organization, tools and know-how to give you specialized assistance on wiring, lighting, signaling, power supply, electronic, from offices and warehouses in over 80 cities, helping them to help you by supplying the newest and best in electrical materials.

Graybar
Executive Offices: Graybar Building, New York 17, N.Y.

This GRAYBAR advertisement is appearing in the April issue of *Architectural Forum* — a special number devoted to Community Buildings and Neighborhood Development in Post-war Housing. Through this campaign, America's leading architects and builders are learning how you can serve them better today and tomorrow, backed up by GRAYBAR supply service.

3519

MOTOR SHOP LAYOUT Speeds Repair

New production methods and continuous flow layout speeds repair and efficiently utilizes floor space in prominent Southern motor shop.

SHOP output of 200 to 300 fractional horsepower motors a week, capacity for handling peaks as high as 500 and speeded repair schedules are the broad results of a planned layout and methods program instituted at Southern Electric Service Company in Charlotte, North Carolina.

Wallace W. Hanks, head of the company, sought to meet the expanded motor service needs of the war-busy textile industry in the area with larger facilities and more effective use of existing floor space. An addition to the plant was built, stripped to the barest essentials and devoted to storage of new and used motors, controllers, wire, conduit and heavy materials. The re-

lieved production space was reorganized under the direction of the operating division managers, Chas. A. Morris handling small motor repair, H. S. Furman on large equipment repair and James T. Meador for construction and industrial maintenance. The results of the planned production were immediately apparent in better customer service and greater shop capacity.

The new addition has permitted a rearrangement of benches in the small motor area to provide for a continuous flow of motor parts throughout the shop without loss of time and effort in handling and transporting. The accompanying floor plan shows the channeling from start to finish. As one worker



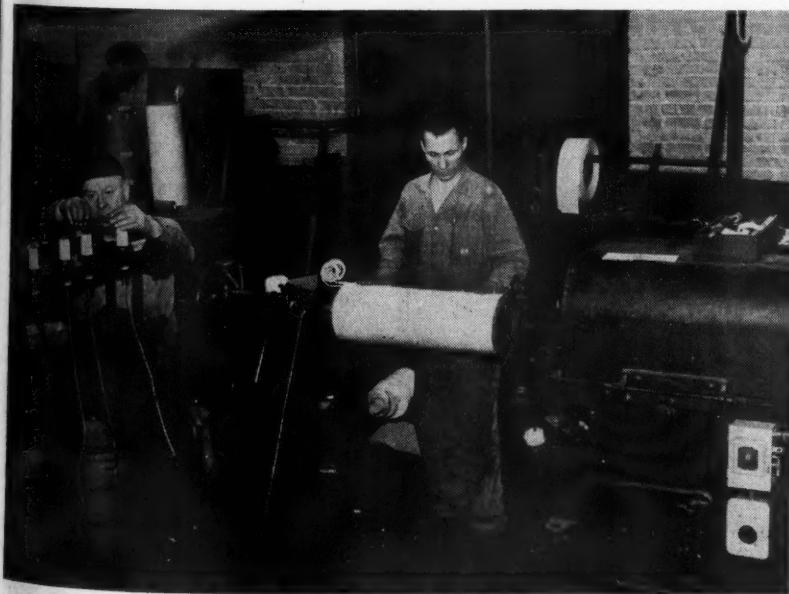
WALLACE W. HANKS whose Southern Electric Service Co. operates in three separate divisions, small motor repair, large equipment repair and electrical construction.

finishes his operation he has merely to turn around and place the tray of motor parts into the hands of the next man performing the next operation.

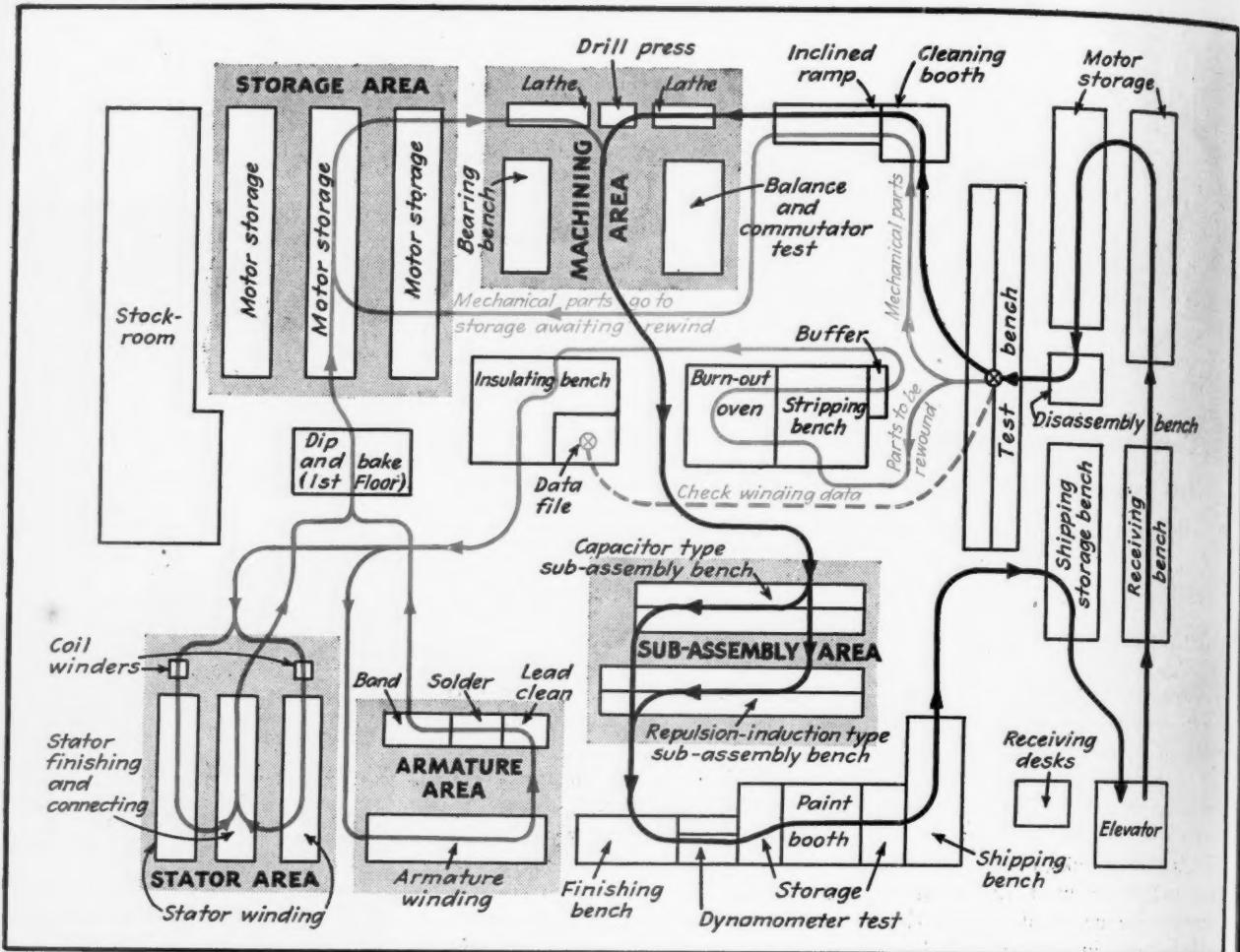
The output of the shop at present is between 200 and 300 fractional horsepower motors per week. Floor space and facilities give a maximum capacity for handling around 500 motors per week but current material and manpower conditions do not permit capacity operation. In one instance, special type commutators have been on order for as long as 15 months. Turnover of manpower has been considerable, and as always, production suffers during training periods. A number of women have replaced men gone into the services and are proving satisfactory.

Repairs are divided into five categories for shop procedure and eventual billing.

1. Minor repair — disassembling, cleaning, inspecting, testing, soldering,



TRANSFORMER COILS are wound on this custom-built machine. Transformer is being assembled on left in front of machine.



APPROXIMATE SHOP LAYOUT with continuous arrows showing how the motor is channeled through the small motor repair division. Black line shows the path of a minor repair job (no part rewound). Red line shows path for motors requiring a rewind. Dotted line refers to check of data files for winding information on the particular motor to be rewound. Note that the armature

tures and stators which require rewinding take one route, while their mechanical parts are first cleaned and then sent to storage to await return of the frames from the bake oven. The complete tray of parts then goes to the machining area, and on to the sub-assembly, and so on, following the same procedure as that required for minor repair.



ARMATURES AND STATORS to be rewound are channeled across the insulating bench where they are prepared for insertion of coils.



DATA FILE where all winding information becomes a permanent record. Data is copied onto tag as a guide for the winders.

turning commutator, and replacing all necessary parts such as brushholders, brushes, bearings, or oil wicks, and refinishing with lacquer.

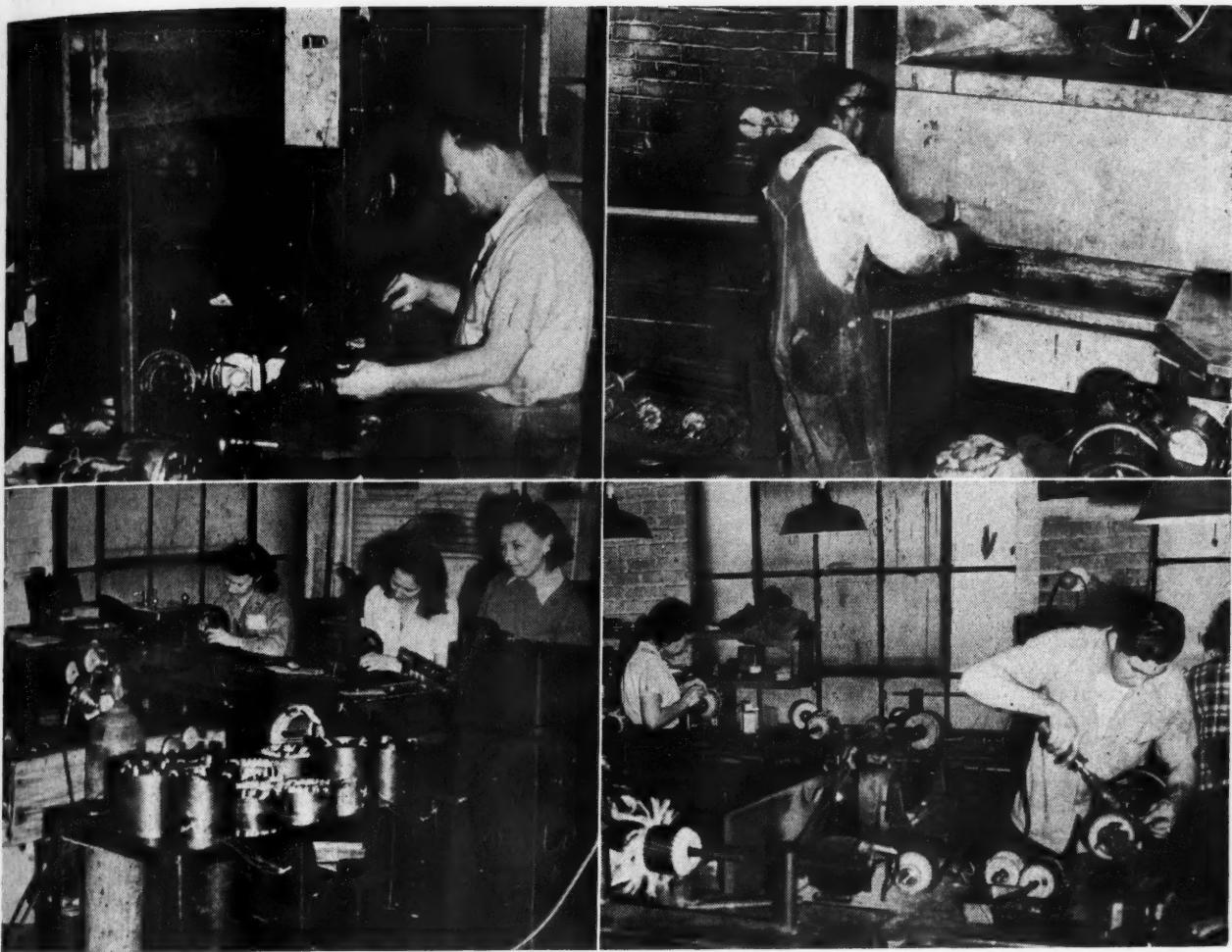
2. **Major repair**—includes all under minor repairs, and the rewinding of either the armature or stator (not both) and includes commutator.

3. **Complete rebuild**—includes all under minor repairs, rewinding both armature and stator, and commutator.

4. **Minor repair and condenser**—includes minor repair and condenser replacement.

5. **Major transformer-condenser repair**—includes all under minor repair and replacement of transformer-condenser assembly with a condenser-start unit.

The small motor division occupies the entire second floor of the plant and all motors received come up via the elevator. They first occupy the receiving bench where the motor is tagged



INITIAL TESTING is done at this bench. Depending on type, some are disassembled before test, others after test. Note tray with each motor and overhead trolley.

STATOR WINDING department where coils are wound, inserted, connected, welded and tested preparatory to baking. (lower left)

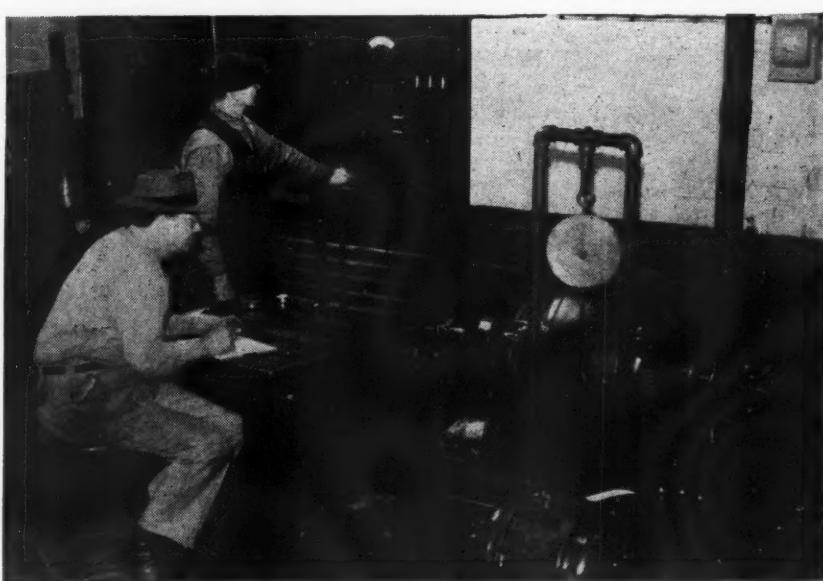
ALL MECHANICAL PARTS are cleaned and sent down ramp (on worker's left) to machining area. Shelf under ramp provides storage for armatures.

ARMATURE WINDING department. Winding bench is against window. Lead cleaning, soldering, banding and testing is done on bench in foreground (lower right).

and given a work-and-order number. It then goes to the next bench where it is completely dis-assembled, and all parts placed in a metal tray to which the tag is transferred.

Trays are then placed on the long test bench. The test unit rolls from one end of test bench to the other on a suspended wood trolley. This unit includes a radio type transformer supplying 90 mil—1200 volt test leads, another set of test leads with a wattmeter with scale 0—1500 watts, and a third set of test leads with lamps in series for continuity test.

The tester determines motor and winding conditions and marks the tag accordingly. If only a minor repair is involved, that is, both armature and stator windings are in good condition and no rewinding is required, the tray is placed in the cleaning booth. Motors found to need rewinding are routed through a different channel and will be taken up later.



LARGE MOTORS are given a complete dynamometer test only when customer requests it or when Southern Electric Service Co.'s engineers call for a check for their own information. All motors are given standard A.I.E.E. tests after completion of repair work.



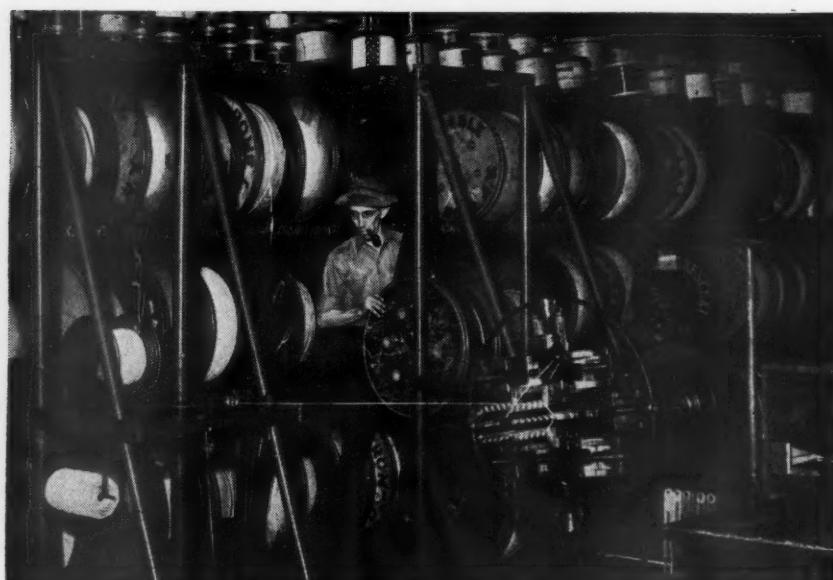
ELECTRIC JIB-CRANE speeds handling of heavy equipment. Tables have casters to facilitate movement for proper light and working angle.

All parts are thoroughly cleaned in a solvent bath and blown-off with compressed air. The tray is then slid down an inclined ramp to machining area.

All the necessary machining is handled on two engine-type lathes and a drill press. Commutators are turned, shafts are machined, new bearings are fitted and reamed to the required tolerances, and the armature is balanced. A three-gang stator connected to a test panel is used to test the armatures for shorted bars. The three stators are standard and of different size to handle the three more common types and sizes of armatures.

The motor parts (still in the tray)

are then passed on to one of the two sub-assembly benches, one for capacitor type and the other for RI (repulsion-induction) type motors. Here adjustments are made, and new switches, governors or short-circuiting devices are installed. A test unit is provided each employee. The test unit includes wattmeter, lamps, test leads with clips, and foot switch. The foot switch permits the worker to energize test leads while holding motor. After proper connections are tested out and soldered, the motor is assembled and tested for free and easy starting. End thrust is removed and the motor is passed on to the finishing bench where bearings are



STOCK OF COIL WIRE is maintained in the large equipment winding department. A U-loop of overhead mono-rail can be switched to carry coils over to the transformer coil winder.

packed, bases are installed, and such miscellaneous parts as end plugs, oil covers, etc., are attached.

It then goes to the dynamometer test bench where it is first given a 1,000-volt-to-ground test for a few seconds.

The dynamometer is then set for 100 percent overload to check starting, brush-setting and breakdown torque. Load is then dropped to normal for a check of normal running current. The commutator is polished with a polishing stone during this normal running test.

The load is still further reduced and by restraining rotation with his hands, the tester checks capacitor motors for dead spots. As a final dynamometer test, enough load is added to check locked-rotor conditions.

The motor is then painted in the spray booth with a clear, quick-drying lacquer, packed and ready for delivery.

Rewinding

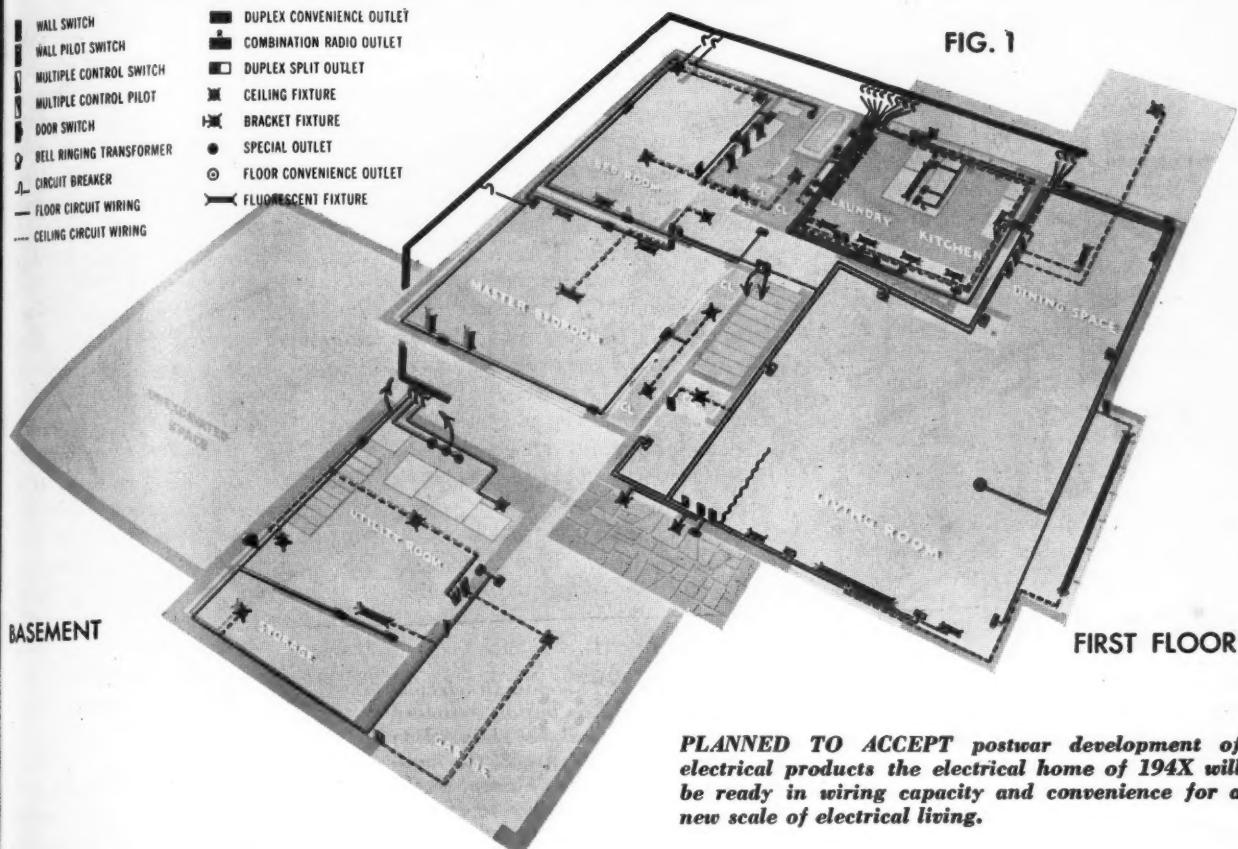
If, during the initial test, it is found that either or both the armature and stator require rewinding, the tester first checks the data file for the winding information on that particular make and type of motor. If the data is not there or does not correspond to the actual winding, he tabulates the complete winding and sends it to the data file where a permanent record is made on separate file cards for armature and stator. Both armature and stator iron are then stamped with the job number for absolute identification after it has been rewound.

The stator (or armature, or both) is then sent to the stripping bench and burn-out oven, while the tray of mechanical parts (carrying the job tag, the number of which is stamped on the stator iron) goes to the cleaning booth. From the cleaning booth, the tray is transferred to storage racks to await the return of the stator from the bake oven.

After the coils have been removed the stator iron is cleaned and buffed and sent to the insulating bench where insulation is cut and inserted into the slots. The data file occupies one corner of this bench, and while one employee insulates, another fills out complete winding information (from the file card) on a tag which is attached to the part to be rewound.

Stators go to the stator winding bench where coils are wound and inserted. Connections are then made temporarily by twisting, and tested. All permanent connections are then made

[Continued on page 177]



TO ACCEPT postwar development of products the electrical home of 194X will wiring capacity and convenience for a electrical living.

Electrical Living in 194X

THE need for one million housing units or more annually in this country of ours, for a period of at least ten years, is well established. This is necessary to keep American housing standards on a basis with the balance of our living economy. Annual net family increases — replacements of units destroyed by catastrophe—or demolished as sub-standard or for commercial expansion require about 900,000 new units annually, while for the past ten years our building rate has been at the yearly average of only 350,000 units. This has created a huge backlog.

Need, however, is one thing. Converting this need into actual houses is quite another. It will require the concerted effort of the entire housing industry to produce a better package—a better living unit—in order for this need to appeal to the consumer on a sufficiently strong basis to compete against the automobile, the delayed vacation, fur coats, jewelry, and a

Previewing the market potential for electrical products in the postwar home, a broad educational program by Westinghouse emphasizes modern wiring as the first big job. Here is realistic planning. Here is strong promotion that will bring direct benefits to the electrical contractor.

By I. W. Clark

Better Homes Department
Westinghouse Elec. & Mfg. Co.

thousand other consumer items which will be strenuously fighting for a share of the surplus consumer dollars that will exist at the end of the war period.

A careful check of data compiled by the country's leading authorities indicates that one should expect housing construction to develop on the following approximate schedule:

First year—350,000 to 400,000 units
Second year—500,000 to 600,000 units

Third year—700,000 to 800,000 units

Fourth year—900,000 units

Fifth year—1,000,000 units or more

These figures are reasonable and within the ability of the housing industry to accomplish and the public to absorb.

New housing, however, is only a part of the story. When the war is over, 15 years will have elapsed since there has been any important amount of modernization or repair. A crying

FIG. 2

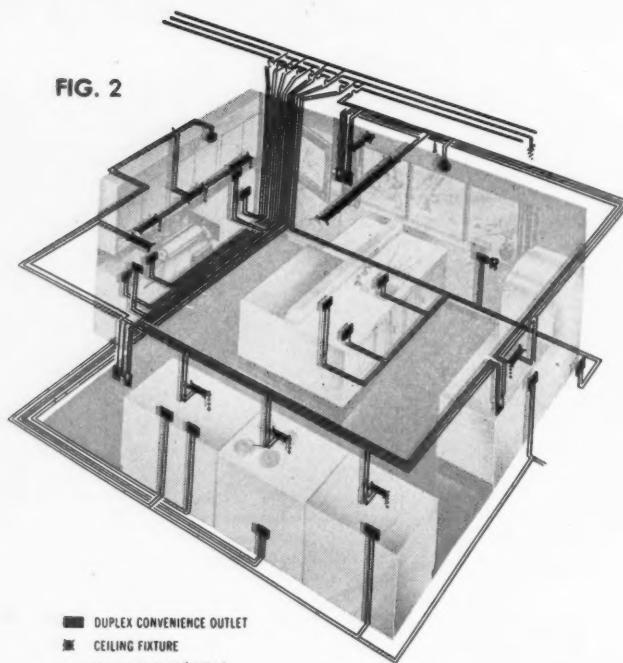
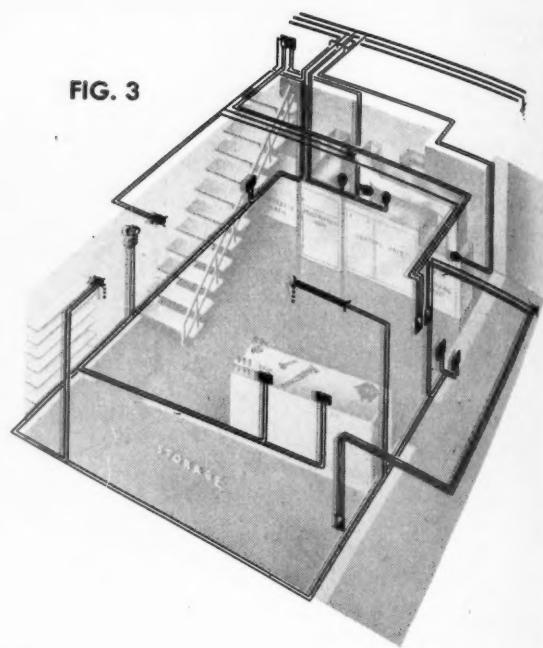


FIG. 3



ENOUGH OUTLETS, enough circuits for proper load distribution, modern circuit protection will be featured in the postwar home. Figure 2, the laundry and kitchen and Figure 3 the utility room show a pattern of circuits and outlets that will clear the way for electrical growth.

need for fundamental repairs and a tremendous demand for modernization of our present housing structures have existed for many years. During the transition period from war to peace, repair and modernization should be the major factors in our housing efforts. With proper stimulation, the number of dollars which will be spent in the first one or two years immediately following the war for modernization and repair will not only equal, but will probably exceed by from 25 percent to 50 percent, the number of dollars spent on new housing construction.

New housing construction of the magnitude just projected will require large volumes of permanent public works, such as—streets, sewers, water systems, sewerage disposal plants, play-grounds, schools — commercial and public buildings. This volume is estimated to be at least equal to the number of dollars invested in new housing. A great deal of this "heavy construction" should take place in advance of actual housing operations.

The actual potential of the three phases of the total housing market:—1) the new;—2) the modernization;—

and 3) the permanent public works and commercial buildings represent a major opportunity for the electrical industry. It will be the first peak housing cycle in which electricity has played an important part.

The success of our participation in postwar housing, in fact in all electrical contracting and merchandising, will depend upon just how well we promote our wares—upon our close cooperation with the housing industry—upon how well we do our jobs.

The Electrical Home of Tomorrow

All signposts indicate that all new homes of 194X will be electrical. Strong indications point toward a greater use of electricity in existing homes. Both of these factors are based upon the following points:

(1) Electrical energy has been a major factor in the vast and amazing production of war goods and materials. Its production has been greatly expanded. As we turn from war to peace, vast amounts of energy will be available to play a *major* part in raising the standards of American living.

(2) Never in history has man had

as flexible a source of power and energy as that of electricity.

(3) The history of rate structures over the past two decades has been one of greater service and lower cost to the ultimate consumer. Electrical power is the least expensive of all "essential household services".

Wiring Is Bottleneck

A long and careful study has revealed a serious and major bottleneck to future home load building programs. House wiring has not kept pace with increased appliance use, nor with the increased wattages as applied to individual units.

Wiring in better than 95 percent of America's homes is inadequate to carry efficiently the present lighting and appliance loads. Corrective action is a *must* in both new and old homes.

The penalty that is placed upon the sale of some major appliances as the range, water heater, and the drier, because of inadequate wiring, has greatly retarded the use of these important units in many areas. It has deprived thousands of home owners who can use appliances of this nature of the

convenience that it can bring to them.

A study of service problems indicates clearly that far too high a percentage of service calls, including those of changing fuses, are caused not by defects or imperfect performances on the part of the appliances, but by poor wiring, overloaded circuits, insufficient outlets, and improper and antique circuit protection.

Any program that increases the appliance load in the average home must be accompanied by a well-organized wiring activity.

Every appliance, be it of the small table variety or a major unit, has a wiring characteristic and should be sold with full knowledge to the purchaser that only when these characteristics are satisfied will the appliance render its intended efficiency.

The Adequate Wiring Bureau has struggled long with this problem. Some progress has been made—a great deal remains to be accomplished. It is an industry problem, the solution of which will require an *all out coordinated effort* on the part of every contractor—every electrical manufacturer, every architect, every engineer and every utility as well as bankers, insurance companies and Federal

Financial Institutions—if the goal of the potential kilowatt hour consumption—of full appliance use—of electrical living—is to be accomplished.

Realizing the importance of this matter, we have developed an educational program for use by the contractor and the electrical manufacturer, every architect, every engineer, the builder, the utility, the banker and the insurance companies. Dedicated to the consumer it builds a story of comfort, convenience, the joy of electrical living and the fundamentals necessary to its efficient operation. We hope to establish in a practical way the advantages of the electrical way of life.

Four basic premises are:

- (1) Enough outlets for present and anticipated appliance and lighting needs.
- (2) Enough circuits to distribute the electrical load properly.
- (3) Modern protection for all electrical circuits.
- (4) Wiring and wiring devices of high quality.

The clearing of the inadequate wiring bottleneck is a *must* to the architect, the engineer, the builder and the contractor in developing a better hous-

ing package in the home of tomorrow, whether it be a new or a modernized residence unit.

It is an industry problem that will take the wholehearted cooperation—a carefully coordinated program—participated in by every branch—every individual in the housing industry and its allied interests.

The technique of using a complete room with the electrical installations in their proper setting—a part of the whole room, with all of its beauty, its comfort, its convenience effectively displayed and known as *ensemble selling* is adaptable not only to the kitchen, but to the laundry—the utility room, yes, even to living rooms, bedrooms and baths. As a matter of fact, ensemble promotions will apply to the entire home—the complete living unit in 194X.

The complete kitchen has in the past been considered to consist of a range and refrigerator, with possibly a dishwasher and disposal unit. Too little emphasis has been placed upon the better location and greater use of the roaster, coffee maker, toaster, electric mixer, waffle maker, kitchen ventilating fan, and the radio.

[Continued on page 176]

INBUILT FLUORESCENT LIGHTING, split control plug receptacles and plenty of circuits feature the bedroom and living room of the 194X postwar electrical home shown in Figures 4 and 5 below. Wiring and

wiring devices of high quality and capacity will set the stage for postwar appliances, radio, television and new home lighting techniques. And new standards of comfort, convenience and better living will come.

FIG. 4

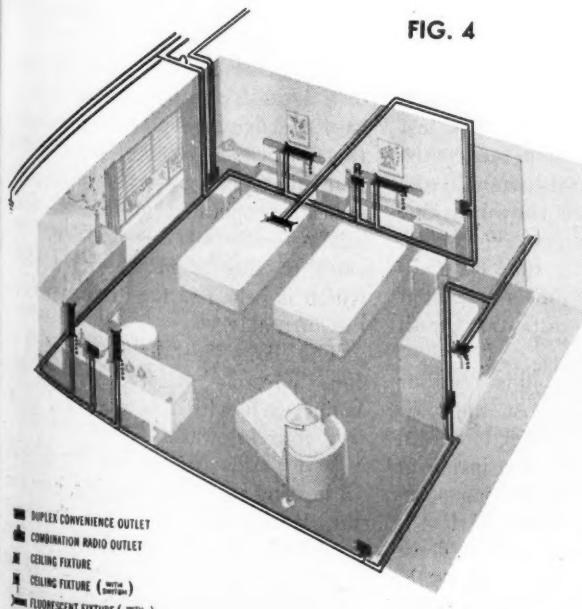
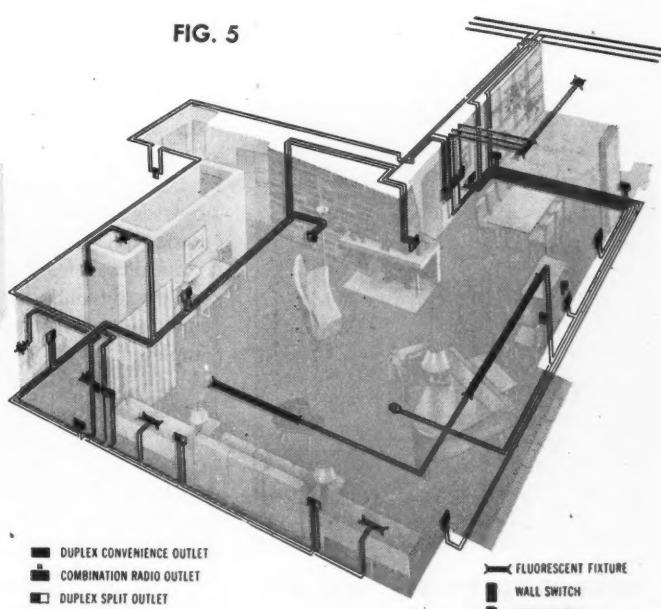
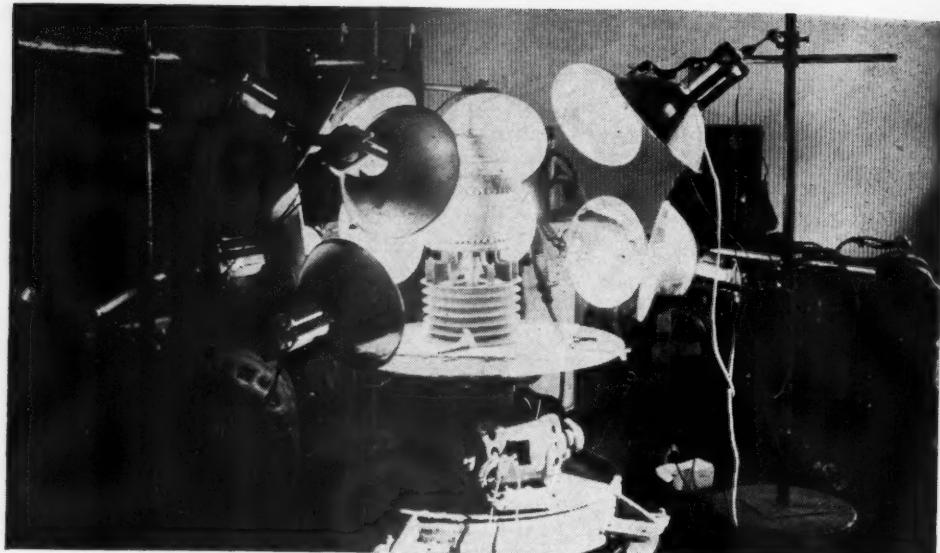


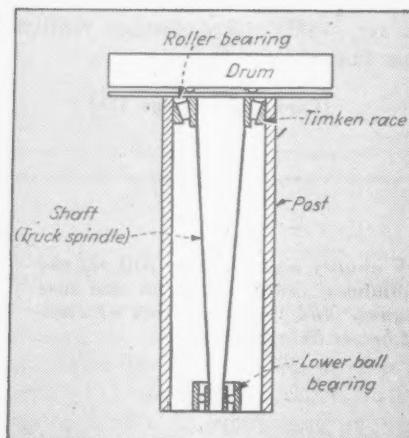
FIG. 5



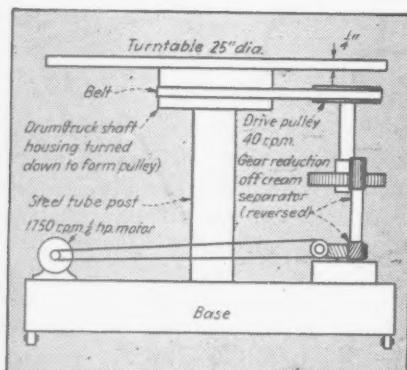
**D R Y I N G
T U R N T A B L E,**
driven by a
small motor,
prevents burning.



Turntable for Radiant Drying



DETAIL of turntable drum and bearing support in the steel tube test.



GEAR REDUCER and belts provide 40 rpm turntable speed from 1750 rpm motor. Construction is sturdy. Base is mounted on casters.

Drying time for motor armatures is speeded and burning prevented by rotating the work.

By Henry W. Young

ROY VAN ORTINGHAM, proprietor of the Electric Motor Service Co., Salem, Ore., has been using infra-red lamps for the past 18 months in drying armatures and complete stators. However, he has had trouble due to burning in spots and considerable time was lost in turning the work to prevent this. So he recently designed and built the motor-driven turntable shown in the photograph and drawings. Normally, it cuts down the drying time 60 to 70 percent and once the job is started it requires no further attention until completed.

Upon a metal base rolling on four casters, a steel tube post approximately six inches in diameter is welded in place vertically. On the inside at the top a Timken roller bearing raceway is let in, while a ball bearing is mounted in the lower end. These bearings are arranged to carry the spindle of a truck axle. On the top is mounted the drum or housing from the same truck assembly, the outer surface

of which has been turned down to cylindrical form to make a pulley. The circular turntable, of $\frac{1}{4}$ -in. plate, 25 inches in diameter is mounted on top of the drum.

The turntable is rotated by means of a 1/6th h.p. motor mounted on the base and driving by belt a gear reduction, which is nothing more or less than the gear assembly of a cream separator operated in reverse, shown schematically in the drawing. The shaft of this is fitted with a pulley which is belted to the drum, revolving the turntable.

The lamp installation consists of four portable stands carrying four lamps each with the total load equaling four kilowatts.

Stator coils are still dried in an oven. In heating prior to stripping, however, the lamps are used and the work mounted on the turntable. In this case the ends of the coils are cut off and the heat applied with the table stationary. About half an hour is required to soften the varnishes.

NECA SPECIAL MEETING

In St. Louis

Electrical contractors to conduct general conference in St. Louis April 15 and 16. Constitution changes and postwar plans to be discussed.

A SPECIAL general meeting of the members of the National Electrical Contractors Association is scheduled for the Hotel Jefferson at St. Louis, Missouri, April 15 and 16. A meeting of the National Apprentice Training Committee preceding the General meeting, will be held on April 13 and the National Executive Committee will meet on April 14.

One of the important matters that will be acted upon at the General Meeting will be proposed amendments to the NECA Constitution changing the governing body of the Association by providing for a Board of Governors, composed of a representative from each of the Chapters, and an Administrative Committee composed of the president, six vice-presidents and the chairman of any Special Benefit Activity committee, who will be responsible for the management and ad-

ministration of the affairs of the Association in place of the present Executive Committee.

A promotion campaign to reach postwar markets will be presented to the conference by Walter Funnell and Frank C. Peterson of the Alan Bridgeman Sanger Agency.

Joseph D. Keenan, vice-chairman, WPB will discuss reconversion to civilian production. Labor leaders including E. J. Brown, president, IBEW and M. H. Hedges, co-chairman of the Labor-Management Committee will discuss employment stabilization and the future of the industry.

Arrangements for the meeting are under the direction of Pres. R. W. McChesney, the executive committee and committee chairmen and General Manager L. W. Davis. NECA national headquarters are at 633 Investment Building, Washington 5, D. C.



NECA President Robt. W. McChesney

NECA TENTATIVE PROGRAM

Hotel Jefferson, St. Louis . . . April 15-16

Saturday, April 15

"Charting Our Postwar Course"
Robt. W. McChesney, President
NECA, Washington

"Promotion Program to Reach Postwar Market"
Walter Funnell and Frank C. Peterson, Alan Bridgeman Sanger Agency, New York

"Reconversion to Civilian Production"
Joseph D. Keenan, Vice-Chairman for
Labor Production, War Production
Board, Washington

"Stabilizing Employment"
Ed. J. Brown, President, International
Brotherhood of Electrical Workers,
Washington

"Our Future in the Industry"
Marion H. Hedges, Co-Chairman,
Labor-Management Planning Committee
for the Electrical Construction
Industry, Washington

Open Forum—Labor-Management Program

Sunday, April 16

"Overall Apprenticeship and Training"
E. H. Herzberg, Chairman, National
Apprenticeship Training Committee,
Milwaukee

"Apprentice Training for the Postwar Period"
William F. Patterson, Director, Appren-tice-Training Service, War Man-power Commission, Washington

Open Forum—Industry Training Program

Discussion and action by NECA mem-bers on Amendments to Constitution

Discussion and action by NECA mem-bers on National Business Promotional Program

Organizing the National Program



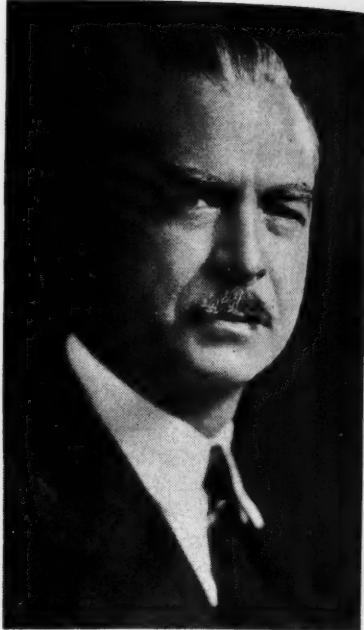
NECA General Manager, Laurence W. Davis



NISA President Charles C. French of
St. Louis



RUGBY H. ST. JOHN, Chief, Electrical & Mechanical Section, Service Equipment Division, WPB, Washington, who will be one of the speakers



NISA Executive Secretary Fred B.
Wipperman

NISA War Conference IN CINCINNATI

Motor shop operators will meet for 1944 War Conference in Cincinnati April 12 and 13. War regulations, better methods, to head meeting discussions.

THE annual meeting of the National Industrial Service Association, streamlined to the business essentials of a wartime conference, is scheduled for April 12 and 13. Members of the motor shop operators group will meet in Cincinnati at the Netherlands Plaza Hotel for sessions developed around two main themes: the contributions of the industrial electric service industry toward

(1) finishing the job of winning the war, and

(2) meeting the problems that will come after.

Mid-week sessions were chosen to avoid travel peaks and centrally located to be readily accessible to members from all parts of the country.

Future developments in CMP regu-

lations with special emphasis on the problems that affect the motor shop will be discussed by Rugby H. St. John of the War Production Board. Other Washington bureau chiefs will tell how the distribution of surplus materials is shaping up. Other problems of national interest including the critical materials situation and manpower scarcity will be discussed.

One session is scheduled to review efforts of NISA and individual shops to improve management and shop operation. A demonstration and contest between various bookkeeping and accounting systems will be staged to bring out the possibilities of improved management and control procedure through properly designed bookkeeping practices.

Entries in the NISA Award contest, a prize competition on improved shop methods, will be placed on display by the Award Committee and the prizes will be formally awarded at the annual dinner.

Several important committee reports are scheduled including that of the War Coordination Committee which will be presented by Chairman William J. Wheeler of New York, New York.

The sessions will be conducted by President Charles C. French of St. Louis with the assistance of the officers, committee chairmen and Executive Secretary Fred B. Wipperman. NISA national headquarters are located at 200 North Broadway, St. Louis 2, Missouri.

ESTIMATING CABLES

In Conduit

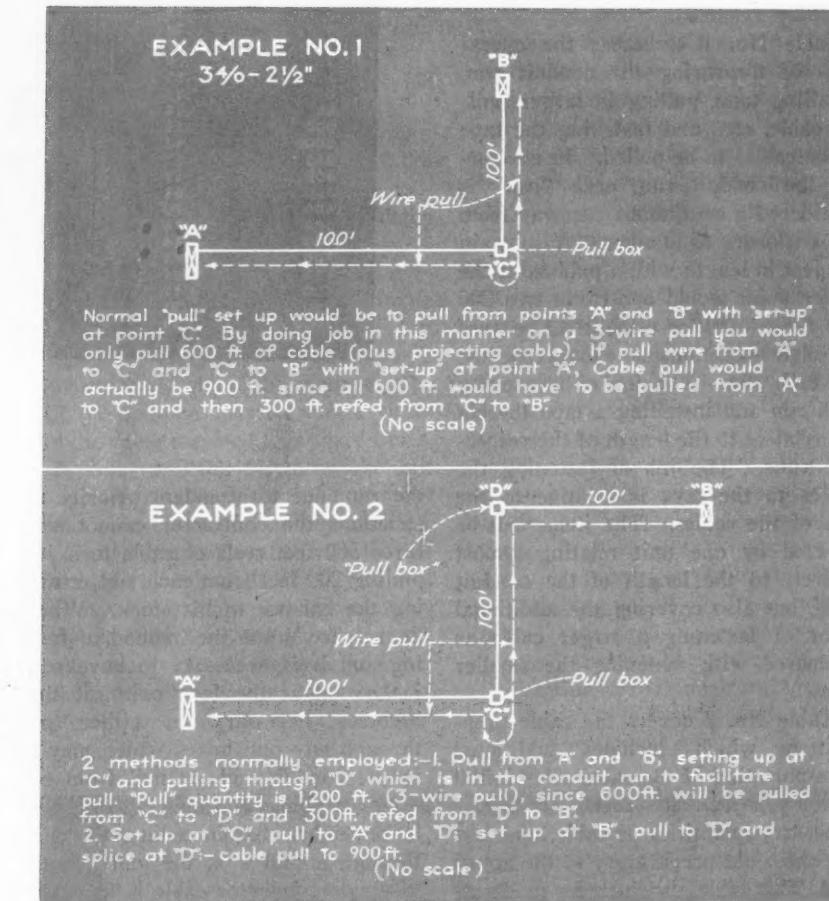
How to figure cable installation time under varying methods of layout and job set-up.

By Leo W. Witz
*Continental Elec. Construction Co.
 Chicago, Ill.*

THERE is probably no portion of a completed electrical contract that can be accomplished with as many varied mechanical methods as the installation of cable in conduit. Fortunately, the method to be employed on any specific job can be accurately foreseen by a qualified estimator at the time of the estimate, and quick "pencil engineering" at that time can result in far more accurate estimates, as well as establishing the mechanical procedure to be employed, and the accessory equipment to be used.

Of necessity, the use of labor units as they relate to a given quantity of material, which may be installed in several ways, requires intelligent analysis by experienced estimators. It is impossible to establish accurate units which will be a mere mathematical calculation to be entered against a given quantity of material without consideration for the job conditions and the job methods to be employed.

If a "cover-all" unit is established, and applied to relatively similar jobs without examining the installation, the estimator is indulging in generalities which may strike a fair average for the years estimating, due to com-



sating factors afforded by "loose" units, but which may be high or low on specific installations.

The discussion hereinafter contained relates to the installation of Type R cables in a conduit run which is essentially HORIZONTAL, with short vertical runs at the extreme ends of the pull. This is usually the type of pull encountered, and the mechanical methods to be employed on long vertical pulls are so varied due to job conditions, that each should be considered separately.

The probable labor items comprising a total cable installation can be

listed as follows:

- 1 Measurement of quantity of cable to be pulled in conduit.
- 2 The installation of a tape.
- 3 Transporting reels, etc., from point of original deposit to "set-up" location.
- 4 Jack up reel or reels, removing specific lengths of cable if necessary.
- 5 Fasten cables to pulling tape or cable.
- 6 Setting winch, snatch blocks, etc., if necessary.
- 7 Pull cable.
- 8 Clean up.
- A labor unit, being formulated to

TABLE No. 1 "SET UP" PREPARATORY TO PULLING CABLE

Includes measuring each conduit run, installing tape, and fastening cable to tape, or accessory devices

| Length of Conduit Run | #14 to #10 | #8 to #1 | #1/0 to 500MCM | Over 500MCM |
|-----------------------|------------|----------|----------------|-------------|
| 0' - 25' | .40 | .60 | .90 | 1.00 |
| 26' - 50' | .55 | .75 | 1.05 | 1.15 |
| 51' - 100' | .70 | .90 | 1.20 | 1.35 |
| 101' - 200' | .85 | 1.05 | 1.35 | 1.50 |
| 201' - 300' | 1.00 | 1.20 | 1.55 | 1.70 |

include the necessary operations without regard to their chronological sequence, should include as many labor operations as can be grouped within the one unit, to simplify the estimating problem. For purposes of convenience, therefore, the entire labor job has been divided into three tables, with an accompanying graph illustrating the instances when mechanical assistance is normally required.

Table No. 1 embraces the operations of measuring the conduit run, installing tape, pulling in larger pulling cable, etc., and fastening the tape to the cables to be pulled. In measuring the conduit run, each "run" is considered a continuous raceway from one enclosure to another. A submain 400 feet in length with a pullbox at the center point would constitute two 200 feet runs. This is established because the labor operations have to be repeated for each run. The job of measuring each run and installing a tape therein are relative to the length of the respective runs. The job of fastening the cables to the tape is relative to the size of the cables. The items can be covered by one unit relating almost entirely to the length of the conduit runs, but also covering the additional labor of fastening a larger cable as compared with fastening the smaller sizes.

Table No. 2 covers the cable preparation which includes additional transportation of the cable after initial delivery, jacking reels, removing necessary quantities of cable, and laying them out preparatory to the actual pull. This table also includes moderate clean-up such as removal of reels, etc. It does not include any unusual transportation. In preparing cable for pulling, it is well to remember that in over 90 percent of installations observed it was necessary to remove cable from the reels and lay them out.

This sounds very inefficient, but normally the cable pull on long runs is fed from a pull box both ways. If the cable is on separate reels, half of the pull can be made from the jacked reels, but to accomplish the other half means to either cut the cables, pull in the other run and splice at the pull box, or take the cable off of the reels. Even under relatively ideal conditions, where no pullbox has been inserted in

TABLE No. 2 "SET UP" PREPARATORY TO PULLING CABLE

Includes normal moving from point of original deposit on job site, jacking reels, unrolling necessary quantities of cable, and laying cable out for pull. Units apply to each cable in pull. (3 wire pull multiply applicable unit by 3).

LENGTH OF TOTAL CABLE PULL DETERMINES UNIT TO BE APPLIED.

| | 0' to 25' | 26' to 50' | 51' to 100' | 101' to 200' | Over 200' |
|------|-----------|------------|-------------|--------------|-----------|
| 14 | .05 | .10 | .15 | .20 | .25 |
| 12 | .10 | .15 | .20 | .25 | .30 |
| 10 | .15 | .20 | .25 | .30 | .35 |
| 8 | .20 | .25 | .30 | .35 | .40 |
| 6 | .22 | .28 | .33 | .40 | .45 |
| 4 | .24 | .31 | .36 | .45 | .50 |
| 3 | .26 | .34 | .40 | .50 | .65 |
| 2 | .29 | .38 | .45 | .55 | .75 |
| 1 | .32 | .42 | .50 | .60 | .85 |
| 0 | .35 | .46 | .55 | .65 | .95 |
| 00 | .39 | .50 | .60 | .75 | 1.05 |
| 000 | .44 | .56 | .68 | .85 | 1.15 |
| 0000 | .48 | .62 | .74 | .95 | 1.25 |
| 250 | .53 | .69 | .82 | 1.05 | 1.35 |
| 300 | .58 | .76 | .90 | 1.15 | 1.45 |
| 350 | .64 | .83 | 1.00 | 1.25 | 1.55 |
| 400 | .70 | .90 | 1.10 | 1.35 | 1.65 |
| 500 | .76 | .97 | 1.20 | 1.45 | 1.75 |
| 600 | .84 | 1.07 | 1.35 | 1.60 | 1.90 |
| 700 | .95 | 1.25 | 1.50 | 1.80 | 2.10 |
| 750 | 1.05 | 1.40 | 1.65 | 2.00 | 2.30 |
| 800 | 1.15 | 1.55 | 1.80 | 2.20 | 2.50 |
| 900 | 1.25 | 1.70 | 1.95 | 2.40 | 2.70 |
| 1000 | 1.35 | 1.85 | 2.10 | 2.60 | 2.90 |

the run, due to attendant priority restrictions the contractor cannot send three 500 feet reels of cable to a job, pulling 200 feet from each and returning the balance to his stock. Where floor space limits the method of feeding and it is necessary to have reels jacked up at the feed point, it then becomes necessary to either pull through any pull boxes which may be in the conduit run, or pull from two or more points and splice. It is well to remember that in pulling the cable through a pull box, the pull quantity of single conductor cable is increased. For example: If a 200 ft. run of three cables has a pull box in the center point of the run, and if the cable is to be drawn through the pull box, instead of pulling 600 feet of single conductor cable, 600 feet is being pulled to the pull box and 300 feet to the other terminal. Although the total quantity of wire would measure 600 feet the amount of cable pulled was the equivalent of 900 feet.

The unit set forth in table No. 2 applies to each cable in the pull. If three cables of one size and a smaller neutral cable were used, the total labor unit for the cable preparation would consist of the totals of the four cable units.

Table No. 3 covers the cable pull only. The unit applies to single conductors. If four conductors of a given size are being pulled in one conduit the unit would be found in column headed "four cables in same conduit." The quantity would be the cable total length, and not the length of the conduit run. Hence in a 200-ft. conduit run with four cables, the unit would be multiplied by 800 feet. To the actual cable length must be added the quantities of excess pull, where the cable is pulled through a pull box, as described above.

The graph is based upon the pulling by hand of 120 lbs. per man, around two elbows. Since it is very difficult to contemplate the number of men which will be on a job at a given time, it was estimated that two men pulling would be the usual condition, with one man feeding the cable. When the cable weight exceeds 120 lbs. per man pulling, the cable pull becomes difficult. The efficiency factor of men pulling falls greatly when more than two coordinate the pulling pressure. The use of a snatch block is usually imperative on an under floor run where the cable must be pulled UP. Usually the snatch block can be mounted above the conduit and the

ELECTRONIC MOTOR DRIVE

Electronic control, high cycle power and trolley bus duct are features of this machine-tool installation

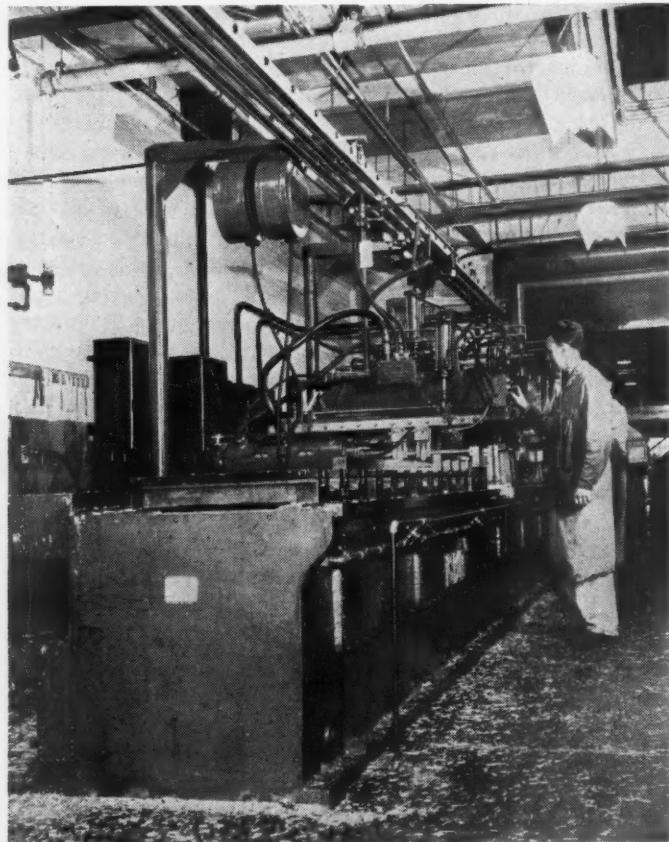
ELCTRONIC motor drive is proving to be the long awaited solution to many industrial application problems. It has many important features and advantages over other types of drive previously employed. Grid-controlled thyratrons supply rectified d.c. current from a single phase a.c. source to the shunt field and the armature, separately fed and controlled. Phase displacement of the alternating voltage on the grid of the tube, controls the current passing from anode to cathode. If the grid is exactly in phase with the anode voltage, the tube is turned

completely "on", whereas if it is 180 deg. out of phase with the anode, the tube is shut completely "off". Thus the output voltage of the two armature-tubes can be varied from zero to maximum which, with full-field, will vary the speed from zero to base speed rating. Then decreasing the output voltage of the field-tubes weakens the shunt field and increases the speed on up to maximum. The entire range of speed is controlled from the single dial of a potentiometer, half the dial covering the armature control range, the other half covering the field con-

trol range. Two dials are generally supplied on the pushbutton station so that both a forward and reverse speed may be preset; pressing either forward or reverse button will give operation in the desired direction at the desired speed. For a more complete explanation of this newly developed electronic motor drive see *Electrical Contracting*, November 1943 and page 108 this issue.

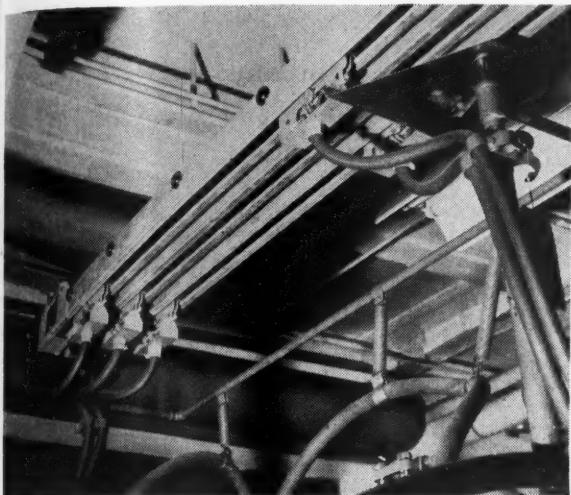
The accompanying pictures show a typical application of this new drive to an Onsrud spar milling machine installed at Brewster Aeronautical Corporation, New York City. The machine is used exclusively for milling aluminum stock into aircraft parts. The bed of the machine is stationary, while the carriage (on which is mounted all the cutting motors) moves back and forth making the required cuts. An electronic motor drive is used for controlling the carriage movement. Four separate mountable pieces of equipment are entailed in the carriage drive. One—the anode transformer which takes 208 volt 60 cycle single phase power from the overhead trolley duct and transforms it to the correct voltage required for supplying a standard d.c. motor with rectified current. Two—the main panel control cabinet in which is mounted the four thyratrons, the seven radio-type control tubes, the anode fuses, filament transformers, adjusting potentiometers and all the accessory elements such as capacitors, resistors, etc., required for successful operation of the electronic circuits. Three—the pushbutton station which is provided with a forward and reverse potentiometer, forward and reverse pushbuttons and a stop button. Four—a 230 volt d.c. motor rated two horsepower.

The motor is geared down to the stationary bed of the machine, and as it operates in forward and reverse, it moves the carriage back and forth over the work. The speed range in this particular case is such that the carriage speed may be varied from one foot per minute to 18 feet per minute. The bed-speed-regulation for any pre-

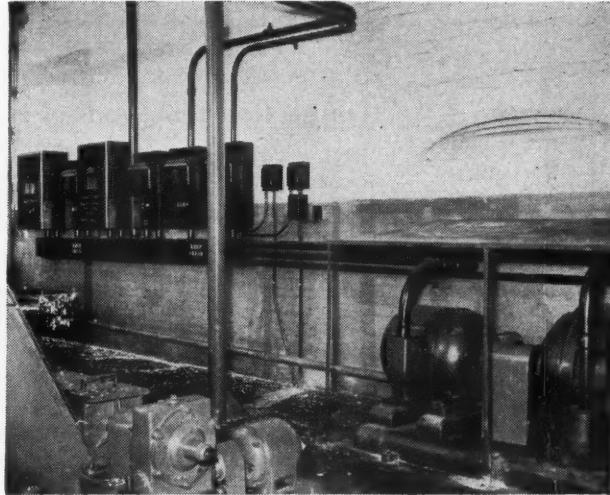


ELECTRONIC MOTOR DRIVE is used to move the carriage of this Onsrud milling machine back and forth over the work (aluminum stock) secured to the stationary bed. Each of the bus ducts are three conductor. The two reels hanging from the bus-duct-support carry synthetic rubber hose aboard the traveling carriage to supply cooling oil for the motors and cutting oil for milling operations. Note the rubber-covered flexible conduit from junction box in center to the horizontal cutting motor. Operator is pre-setting speed adjustment at pushbutton station potentiometer.

VE of ALUMINUM MILLER



RISERS FROM THE CARRIAGE support the collectors. Three runs of 3-conductor Bull Dog bus ducts carries the power aboard the carriages. Two outside runs supply 208 volts 60 cycle. Center duct supplies 440 volt 180 cycle 3 phase power for high speed vertical milling motors. Note pull-box at end of duct. Knockouts open directly into the end of the duct.



BATTERY OF SAFETY SWITCHES and control breakers are mounted on the brick wall within a few feet of the machine. Tailor-made wiring trough beneath the switches carries all circuits. Frequency changer set is located at right. 208 volt 60 cycle induction motor drives a 440 volt 180 cycle induction generator to supply high speed cutting motors.

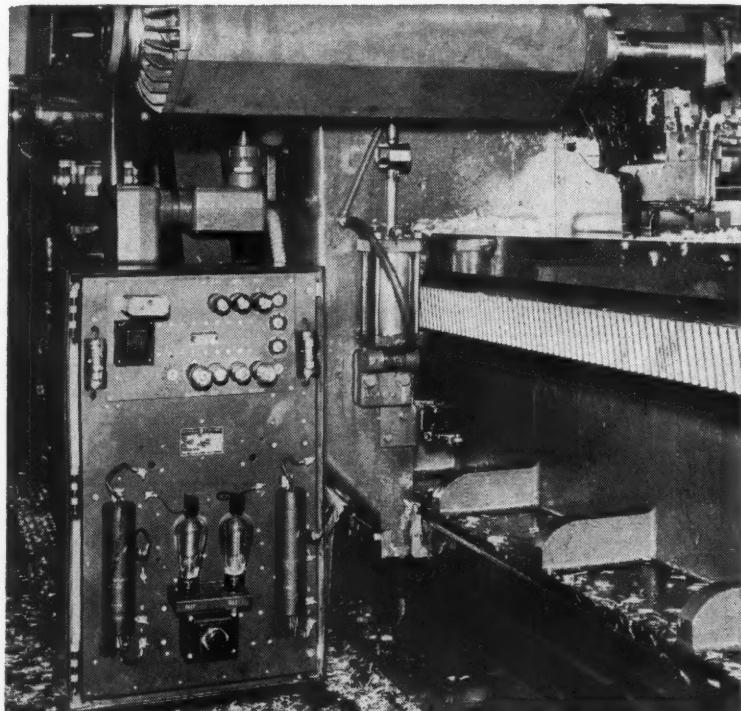
set speed is held automatically by electronic control to very close limits over the entire load range from no-load to full-load.

Cuts are made only in the forward direction at any required preset speed. The carriage is then returned at full speed for the next cut.

Four cutting motors are provided on the machine—two horizontal and two vertical. The two vertical motors are rated each 15 horsepower, 10,000 rpm. The high speed motors are supplied with 440 volt, 180 cycle power from an induction frequency changer set located near the machine.

The two horizontal motors are each rated 30 horsepower, and operate from a 208 volt, 60 cycle supply. In order to get a smaller external circumference on the two horizontal motors, two separate stator windings, rated 15 hp. each are used with two 15 hp. rotors mounted end to end on the same shaft. The motors are cooled by circulation of cutting oil through the outside jacket of the stators. This cutting oil is the same oil used in cutting operations. The oil is piped aboard the carriage via synthetic rubber hose. Hanging from the same overhead support that carries the trolley duct, are two spring-wound reels that pays out the hose.

[Continued on page 121]



THYRATRON TUBES, which convert a.c. to d.c. for the carriage drive motor, are mounted on this hinged panel of the Thy-Mo-Trol control cabinet. Two center tubes supply field current. Two larger outside tubes supply the heavier armature currents. The seven radio-type control tubes and the six adjustment dials can also be seen in the upper part of the panel. On either side of the upper sub-panel is a cartridge fuse connected into the anode circuit for short circuit protection. The d.c. driving motor is mounted directly behind this cabinet. The various circuit breakers are also mounted behind this cabinet. One of the horizontal cutting motors can be seen with two nameplates—one for each 15 hp. winding. Rotors are mounted on same shaft for a 30 hp. motor rating.

OUTDOOR GROUNDING and T

A discussion of factors influencing outdoor grounding connections, methods of reducing ground resistances and test procedures for measuring those resistance values.

THE wartime wave of non-steel plant construction led to an extended use of ground rods on secondary electrical distribution circuits and made the electrical contractor and inspector more conscious of artificial, driven grounds and their inherent problems.

Before discussing factors that normally influence the effectiveness of driven grounds, let's determine the purpose of a ground connection. The Bureau of Standards Technologic Paper No. 108 on "Ground Connections for Electrical Systems" points out that a ground connection should keep some point in an electrical circuit at or as near as practicable to the potential of the ground to insure safety to life and property and to provide increased convenience and continuity of service in the operation of an electrical system.

The term "ground" may mean either the soil itself or the conducting bodies in contact with or extending into it—such as water and gas pipes,

iron poles, building steel, etc. There may be a considerable flow of current through the ground connection with a possible increase in potential, above that of the ground, in the circuit or conducting body. The resistance of the soil to this current flow determines in a large measure the effectiveness of the ground.

Effect of Soil on Resistance

Although the earth may be considered as a conductor with practically unlimited capacity and negligible resistance, all connections to the earth will not have the same characteristics. The electrical conductance of any soil is by means of the electrolytes formed by moisture combining with soluble acids, alkalies and salts. The specific resistance thus depends largely upon the type of chemicals and amount of moisture in the soil.

The Bureau of Standards made a series of resistance measurements in different types of soil and obtained values varying from two ohms up to

around 3000 ohms. Even wider variations are possible, depending upon the particular type of soil, its chemical ingredients, moisture content and temperature.

That part of the total resistance which is contributed by the soil is the most important part of the ground connection. The resistance is made up of all the multiple paths of variable cross-section through the soil surrounding the ground electrode. Considering a driven electrode in soil of uniform resistivity, the greatest resistance is in the soil immediately surrounding the electrode. This is the region of smallest cross-section of soil at right angles to the flow of current through the soil. In the region six inches away from the electrode, the cross-section of soil to carry the current is greater and increases with the distance. The resistance varies inversely as the cross-section. Measurements indicate that 90 percent of the total electrical resistance surrounding an electrode generally is within a radius of 6 to 10 feet from the rod.

Bureau of Standards tests also indicated that the effect of contact resistance between *clean* electrodes and earth when firmly pressed together is negligible so far as practical purposes are concerned.

Moisture is Important

The moisture content of the soil definitely affects the resistance of the ground. A moisture difference of a few percent especially at moisture contents below 22 percent, will make a marked difference upon the resistance. Experimental tests made with red clay soil showed that with only 10 percent moisture the resistivity was over 30 times that of the same soil with a moisture content of 22 percent. Above this value, resistivity is affected

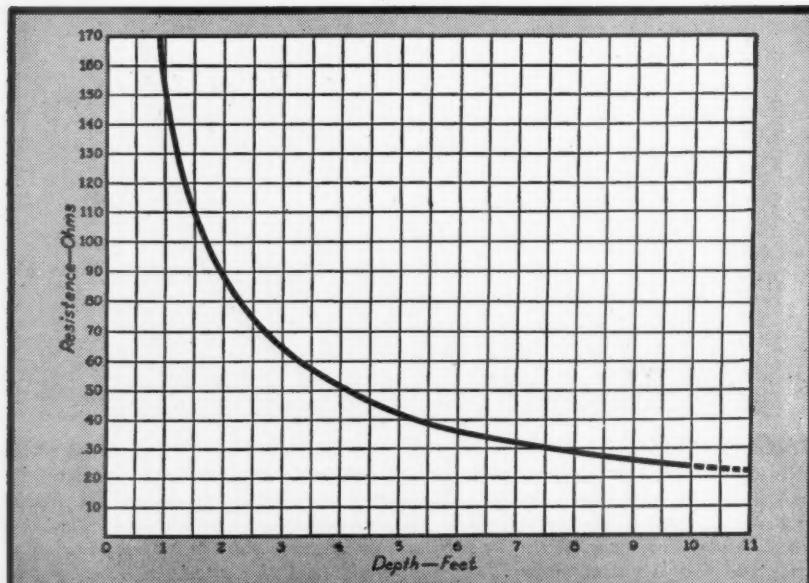


FIG. 1—EFFECT OF DEPTH on reduction of resistance of a ground connection. Greatest reduction occurs in first five or six feet. Recommended length of ground rods is 8 feet.

From a paper presented at the 14th Annual Meeting, Illinois Chapter, IAEI, at Chicago.

and TESTING TECHNIQUES

By Erich G. Elg

Copperweld Steel Company
Chicago, Illinois

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little; below it, the resistivity increases abruptly with a decrease in moisture content.

The normal moisture content of soil varies from about 10 percent in dry seasons to around 35 percent in wet seasons—averaging from 16 to 18 percent. The resistance of a ground connection thus is subject to considerable variation from seasonal changes alone.

Depth and Size of Electrode

The depth to which an electrode is driven is another important factor affecting resistance. The driven electrode should be long enough to reach permanent moisture. Failure to do so results in high resistance and large variations due to seasonal changes.

Soil is seldom of uniform resistivity throughout different depths. Usually the first few feet near the surface, subject to alternate wetting and drying out due to normal rainfall, has relatively high resistance. The underlying strata, however, is more stable and less subject to such fluctuations. Bureau of Standards tests bear this out and show that the greatest reduction in resistance is obtained in the first five and six feet of depth (see Fig. 1), with the biggest differences occurring between the first and third feet. The change in resistance beyond eight feet is so small that an 8-foot ground rod will generally achieve the desired results.

The diameter of an electrode has a negligible effect in decreasing the resistance of a ground, since the soil surrounding the electrode and not the diameter of the rod determines the resistance (see Fig. 2). Tests indicate that by doubling the rod diameter from $\frac{1}{2}$ -inch to 1-inch (an increase of 200 percent in diameter and area and a 400 percent increase in volume of earth displaced), the resistance of a single driven ground was decreased only about $9\frac{1}{2}$ percent. A good rule is to select a diameter of electrode only large and strong enough to permit

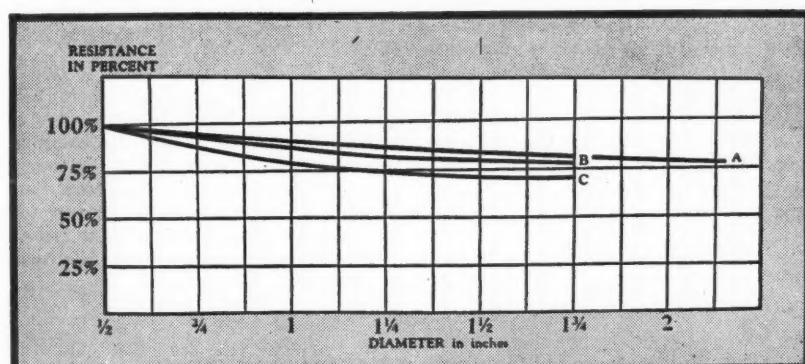


FIG. 2—CHANGE IN DIAMETER of the ground rod has very little effect on ground resistance values (as shown from tests above).

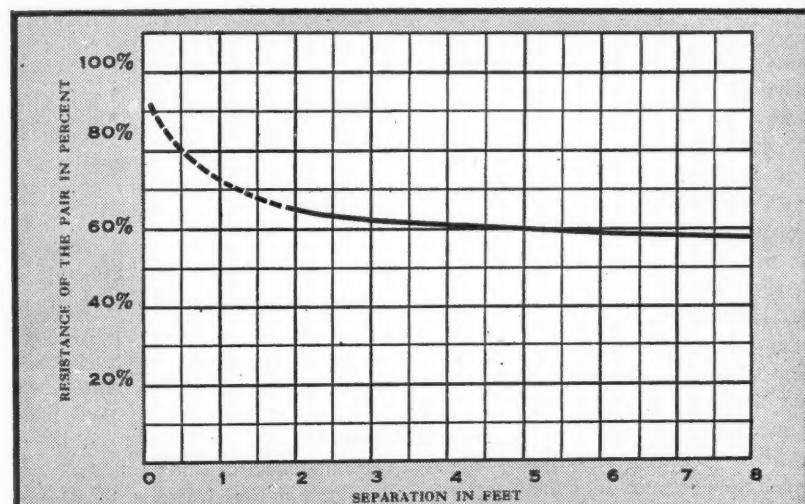


FIG. 3—SPACING OF MULTIPLE RODS has a definite effect. Minimum spacing should be six feet to obtain best results.

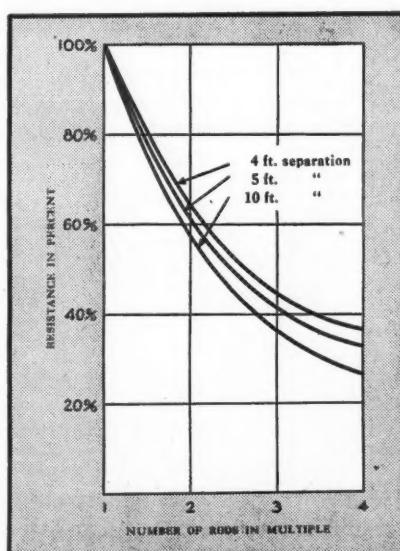


FIG. 4—MULTIPLE ELECTRODES are an effective method of reducing resistance. Chart shows approximate reduction obtained with two or more ground rods.

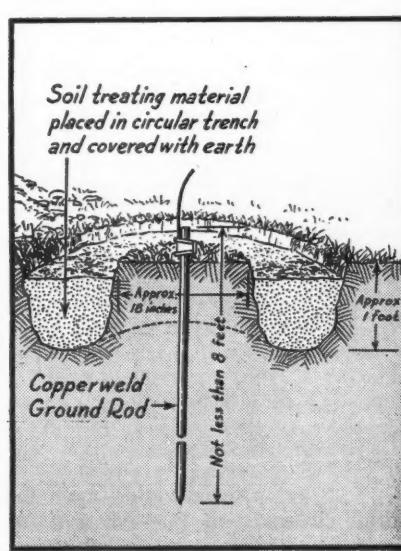


FIG. 5—TRENCH METHOD of chemically treating soil is recommended. Sodium chloride is used to prevent crystals from coming in direct contact with electrode and causing corrosion.

driving it into the soil without bending or splitting it.

Reducing Ground Resistance

The driving of a single ground rod does not always solve a particular grounding problem. In such cases there are several methods of reducing the ground resistance to acceptable values. These include:

1. *Multiple electrodes*—A method suggested by the National Electrical Code is that of driving one or more electrodes and connecting them all in parallel. Since approximately 90 percent of the resistance of a driven ground is within a radius of 6 to 10 feet of the rod, additional driven rods should be spaced at least six feet away from each other (see Fig. 3). With this spacing, each electrode introduces a new cross-sectional area of unused soil. The approximate reduction in resistance obtained with two or more ground rods, compared with the resistance of one rod, is shown by the curves in Fig. 4.

The number of multiple electrodes used depends entirely upon the soil resistivity at the point of installation and the ultimate resistance desired. Economy lies in getting the greatest possible benefit from each of the electrodes—hence the attention to spacing.

2. *Chemical treatment of soil*—Another method frequently used for reducing the resistance of a driven ground is to chemically treat the soil immediately surrounding the electrode. To reduce the resistivity of any class of soil, it is necessary to dissolve in the soil moisture a substance highly conducting in its water solution.

Among the chemicals suitable for this purpose are: sodium chloride (common salt), calcium chloride, copper sulphate, magnesium sulphate (epsom salt), and iron sulphate. Of these, sodium chloride and magnesium sulphate are at present the most commonly used, since some of the others are more or less objectionable from the standpoint of cost, availability and tendency to corrode the electrode when in combination with certain types of soil.

Treatment of the soil adjacent to the electrode can reduce its resistance (according to tests) in the order of 40 to 50 percent, depending upon the initial character of the soil and the degree of treatment. Among the methods of applying this treatment are:

The Trench Method—is a preferred method of soil treatment. The chemi-

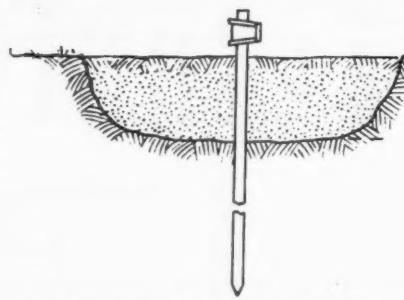


FIG. 6—BASIN METHOD may be used where magnesium sulphate is used since this chemical has little, if any, corrosive effect on the electrode. Generally, it is best to keep the chemical crystals away from the rod.

cal is placed in a circular trench surrounding the electrode (see Fig. 5). The trench should be about 12-inches deep and from 12 to 16 inches away from the rod. Once in the trench, the chemical is flooded several times with water to permit the solution to penetrate the soil. After backfilling, further watering is optional since normal rainfall usually causes a more or less steady flow of the solution through the soil.

The Basin Method—is sometimes used, although not recommended as highly as the trench system. An excavation several feet in diameter and 12 inches or more deep is dug around the electrode (see Fig. 6). The chemical is placed in this "basin" and flooded with water. Magnesium sulphate is recommended for this method as it does not corrode the electrodes as does sodium chloride.

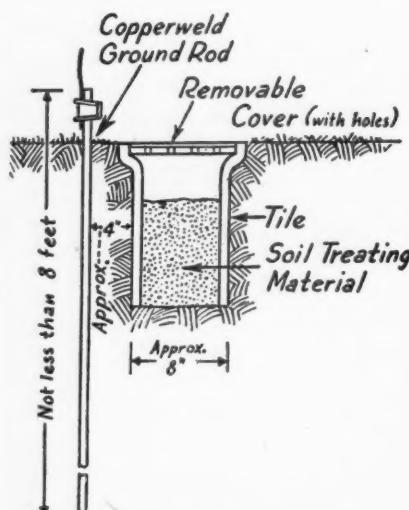


FIG. 7—CONTAINER METHOD is a happy medium between the basin and trench methods. It is particularly adaptable where space is at a premium and provides easy access for renewing the chemical when necessary.

The Container Method—is an improvement over the basin method and an adaptation of the trench method for localities where space is limited. Here (see Fig. 7) the chemical is placed in a 12 or 18-inch length of 8-inch tile pipe "container" sunk into the ground about four inches from the electrode. A removable cover (with holes) facilitates renewal of the chemical and permits surface moisture to enter the container.

The Combination Method—is a combination of chemical treatment of the soil and the multiple driven ground. It proves advantageous in locations where the application of either method alone is not sufficient to obtain the desired ground resistance readings.

It must be remembered that chemical treatment of soil is not permanent in effect and the benefits will disappear after a period of time depending upon the type of soil. Chemicals must be renewed after several years or whenever tests indicate any increase in the resistance of the soil.

Deep Ground Electrodes—are used in locations where low resistance soil lies at a considerable depth below the surface. Such rods are made in ten-foot sections threaded at both ends and joined together with couplings. After the first section is driven flush with the ground, the second section is threaded on and driven in and so on until the desired depth is reached.

Measuring Ground Resistance

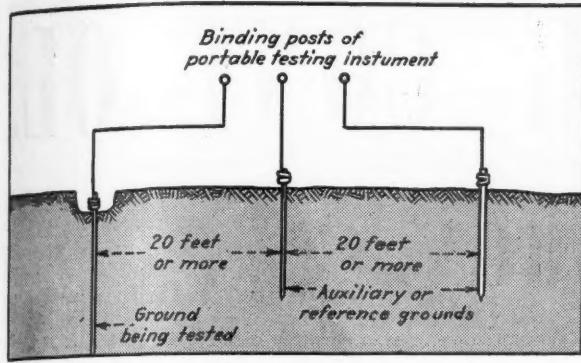
The only authoritative way of determining whether a ground connection has the specified resistance value is to measure it. Usually, exact values are not necessary, it being sufficient to know if the resistance is in the order of 10, 100, or 1000 ohms.

Any method of measuring the resistance of a ground connection requires, in addition to the electrode under test, two independent auxiliary electrodes (usually two or three feet long) placed at distances remote enough from the permanent rod and from each other to minimize mutual effects. Portable, self-contained, direct reading instruments prove most satisfactory.

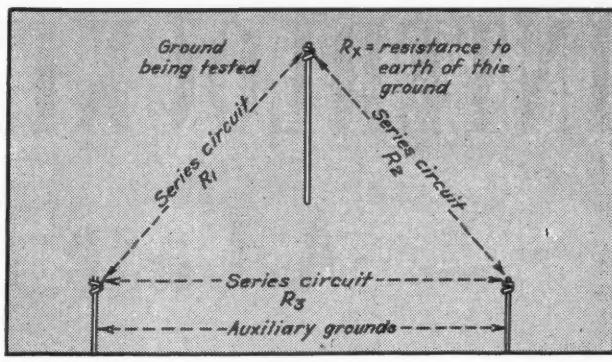
Four distinct methods of measuring resistances of ground connections are described briefly below.

The Single Test Method—requires two reference ground rods, two to three feet long, spaced approximately 20 feet away from the rod being tested (see Fig. 8-A). All three rods are connected direct to the binding posts

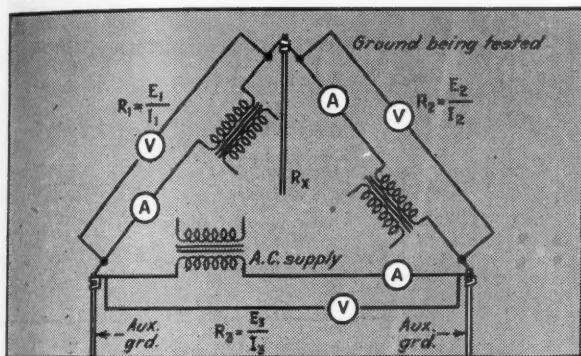
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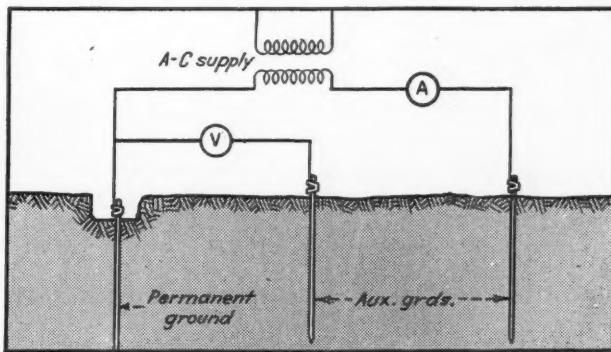
(A) - Single-Test Method
Meter is direct reading



(B) - Three-Point Method
 $R_x = \frac{1}{2} (R_1 + R_2 - R_3)$



(C) - Ammeter-Voltmeter Method
 $R_x = \frac{1}{2} (R_1 + R_2 - R_3)$



(D) - Fall of Potential Method
 $R_x = \frac{E}{I}$

FIG. 8—TEST METHODS for measuring the resistance of ground connections, diagrammatically outlined, above, include (A) the single test method; (B) the three-point system; (C) the ammeter-voltmeter method; and (D) the fall of potential system.

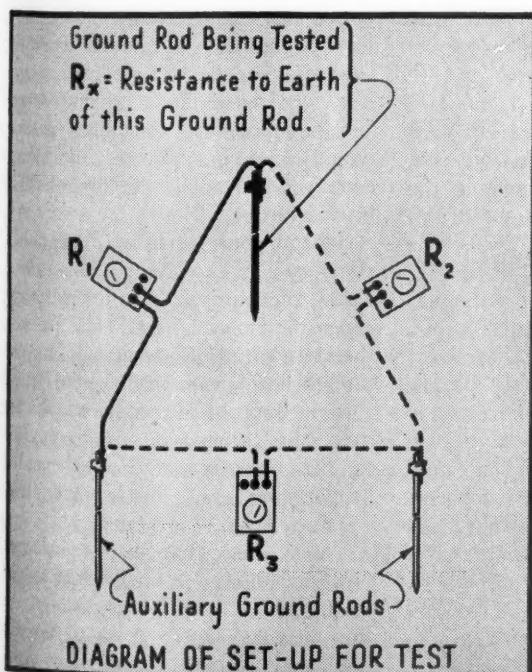
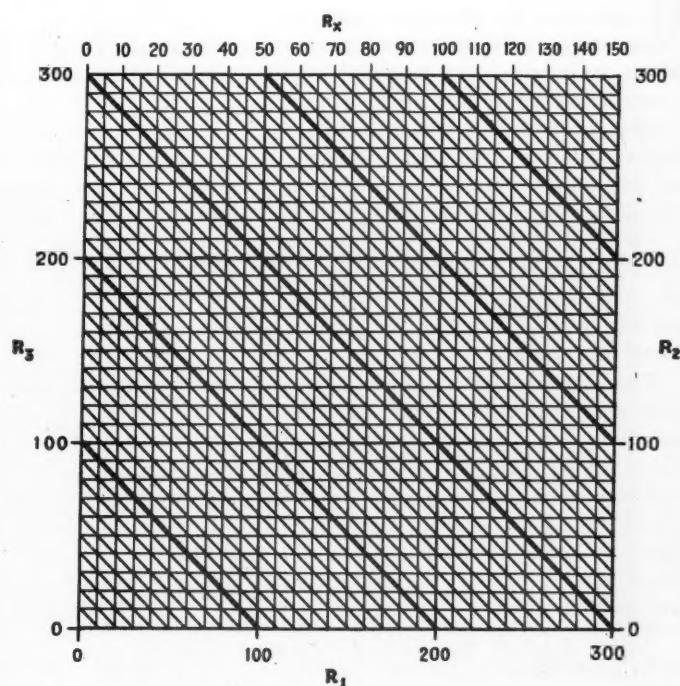
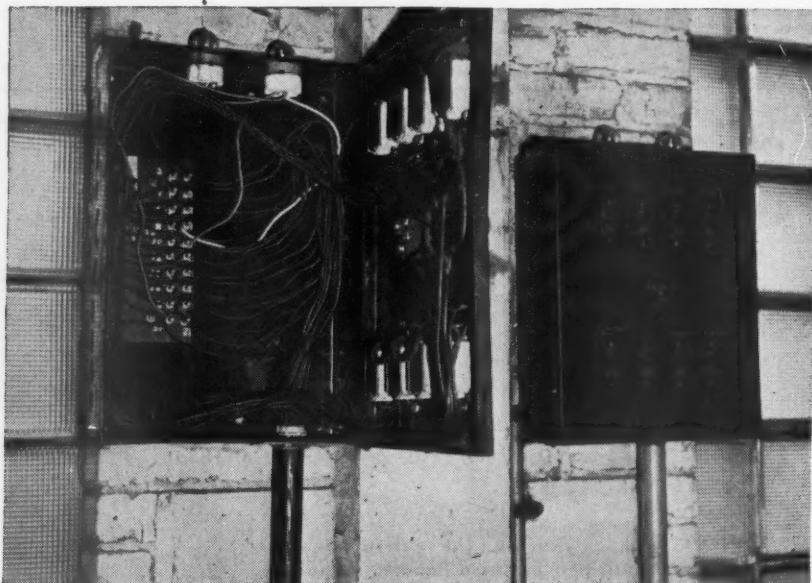


FIG. 9—CALCULATION GRAPH for determining values of R_x without solving equations. Using test setup outlined read values of R_1 , R_2 , and R_3 on meter. Then, using graph, set pencil on value of R_1 on bottom scale. Move pencil vertically until opposite value of R_3 on



right hand scale. Move pencil diagonally until opposite value of R_3 on left hand scale. Then move pencil vertically and read value of R_x on the top scale. This value will be the driven-ground resistance to earth in ohms. (The Pure Oil Company)

INTERLOCKING CONTROL, A Case Study



A Reader's Quiz question asked about a complex interlock problem. Several control schemes were published in answer. The story of the actual job as it was installed is a useful case study of interlocking methods.

ONE of our problems, in substance, was how to connect a bank of starters (all magnetic but two which are manual) so that the "key" motor starts before any of the others; so that all will shut down if the key motor fails; and so that all except the key motor will stop if any one of the others fail.

Such interlocking control requirements may seem a little fantastic but an investigation of the production process revealed that these requirements were vital.

For those who are unacquainted with cigarette manufacture, the process is a very tedious one with all kinds of intricate controls to assure uniform quality in the finished product. From beginning to end, the tobacco must be "coddled" and consequently, electrical control must be carefully interlocked to assure proper processing.

The basis for such "process anxiety" is that according to cigarette manufacturers, a cigarette is either good or it is bad. There is no in between. The determining factor—moisture content and flavoring, which must be the same Sunday, Monday and always.

By R. E. Powell

Chief Electrician,
Philip Morris and Co., Ltd.,
Richmond, Virginia

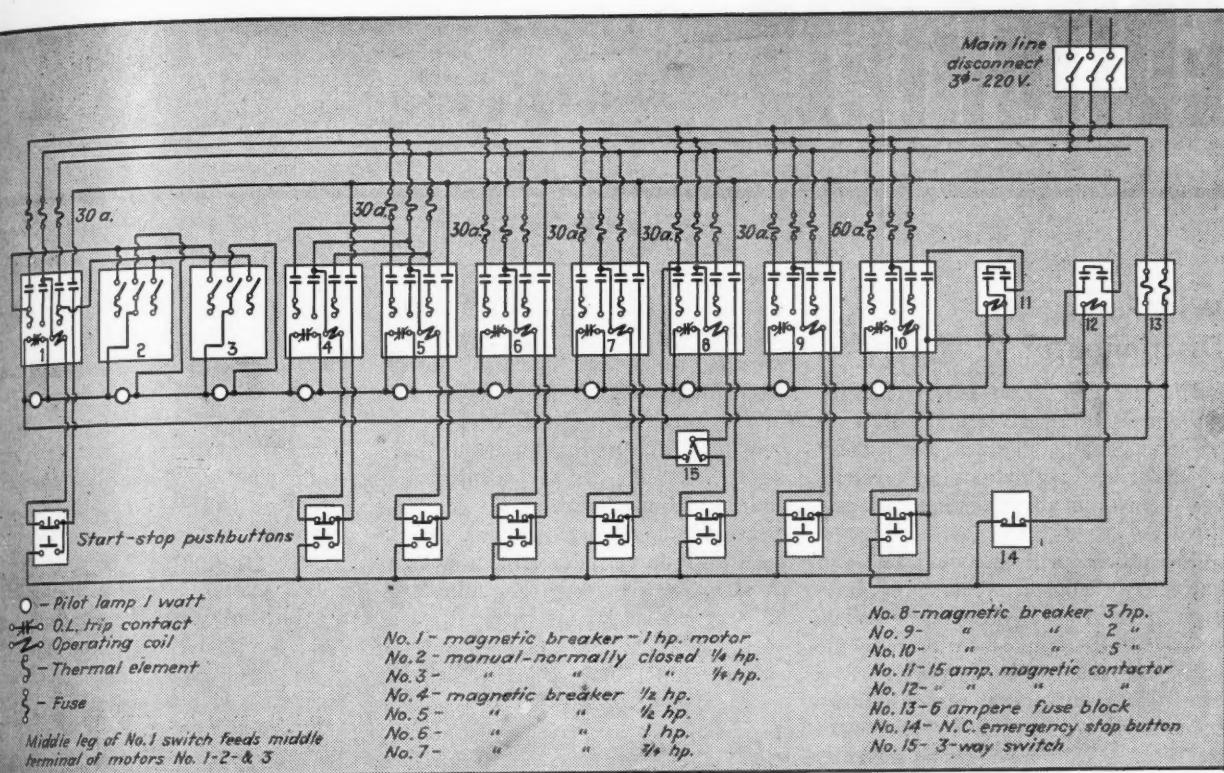
The process entails ten driving motors. The "key" motor, No. 10, is the first encountered, and is the most important. No. 10 motor drives a pneumatic fan which sucks the tobacco leaves from the end of the last inspection conveyor, supplying the material to begin the final processing. The other nine motors are used for rotary drive of huge drying drums, feeder drives, conveyor drives, and fan and blower drives, all having an important effect upon the moisture content and flavoring of the tobacco.

Now to consider the three phases of interlocked control. First, that No. 10 shall start before any of the others. This is important for two reasons. One—the pneumatic fan must be operating before the final inspection feeder-conveyor starts. If this were otherwise, the feeder conveyor might pile too much leaf into the end of the duct through which the pneumatic fan draws the tobacco. Clogging would

result, interrupting the entire process. Two—No. 10 fan must first furnish tobacco to the successive treatment stages before they can become operative, otherwise flavoring and drying in the moisture controlled process would be non-uniform. Both are equally important in this first phase of interlocking.

Second phase, that all motors shall shut down in case No. 10 fails. Here, again, the purpose is to prevent clogging the tobacco-feed duct in case the pneumatic fan should stop and for the further reason that should No. 10 stop feeding in a continuous bulk of load, the thinned-out portion at the tail end of the batch might not be properly flavored, blended and dried, causing it to be rejected.

Third phase, that all motors except No. 10 shall stop in the event of failure of any one or more of the others. Here the purpose is to prevent clogging not only at the initial feed point but at every point throughout the entire process travel. No. 10 must keep running to bring up the rest of the tobacco off the end of the feeding conveyor on a lower floor. This



OVERLOAD TRIP CONTACTS have been removed from automatic trip duty and are used to light signal lamps so that unexpected outage is eliminated. Starters Nos. 2 and 3 are manual and were used because nothing else was available. The manual starters complicated the control scheme unduly but nevertheless a

solution was accomplished. A 3-way switch was wired into No. 8 so that if the occasion should arise, it could operate independent of the rest. Emergency pushbutton No. 14 which operates contactor No. 12 was inserted to gang-stop all except No. 10, which had to keep running to prevent clogging the tobacco feed duct.

feeding conveyor is one of the nine other motors whose control is interlocked, so that it will stop feeding the pneumatic-fan at the end of a short coasting period. The reservoir at the top of the duct has enough capacity to absorb this extra amount of tobacco which might be enough to clog the lower end should No. 10 also stop.

To further emphasize the importance of continued operation, Mr. Powell's solution called for all overload trip contacts to be relieved of their automatic trip duty, and rewired to light a signal lamp should the thermal elements say "too hot." The control board is in constant attendance and the signal light gets an immediate response. This gives the operator an opportunity to prepare for and call a shutdown after summoning an electrician. Such a scheme prevents a completely unexpected power outage but at the expense of burn-out risk. The decision, of course, is dictated by the economics of operation; is it cheaper to have a batch of fine tobacco rejected or to take the risk of a burn-out?

Interlocked control such as this is excellent insurance. Failure rarely oc-

curs, but it is nice to be able to relax, knowing that if one does, you are adequately protected. Additional protection has been afforded at this Phillip Morris plant by strict adherence to a rigid preventive maintenance program. As C. G. Marshall, our chief engineer

says, PM's biggest production headache years ago was licked by the introduction of strict preventive maintenance scheduling.

Our solution to this interlock control problem is shown in the accompanying diagram.



THE BANK of controlling starters have been mounted on a frame located where the operator can easily see and reach. Each starter carries a signal lamp for immediate identification of the failing motor. If the normally-closed O.L. trip contactor should open, a voltage would appear across the lamp, lighting it to signal the operator.

EDITORIALS

W. T. Stuart, Editor

Will Forms Discriminate?

Not too long from now, we hope, the wheels of reconversion will be in motion. Step by step, on some orderly schedule, war regulations and restrictions must be altered, simplified and lifted.

The process will be complicated and extremely delicate. The procedure, even at the risk of becoming cumbersome must be fair, to business, to the consumer and to the taxpayer. And one of the most urgent responsibilities upon those government agencies with the responsibility for relaxing the rules will be a keen appreciation of established distribution methods. An apparently simple procedure requirement, under present controls, can easily shift a whole course of established industrial practice.

A current instance demonstrates this and points a warning. Authorization for the purchase of certain textile machinery is obtained by the customer on a form WPB 1319. If motor and drive are ordered at the same time from the same machinery dealer, one form and one approval is enough. If the motor and drive is bought from a local contractor or motor dealer, separate authorization must be obtained on a WPB 541 form.

The difference in procedure is slight. The approval of the original WPB 1319 practically assures a routine approval of the WPB 541. But rather than take a chance on having it turned down and to avoid filing more than one form, many buyers are ordering motors and drives from the machinery dealer as component parts. The sales work and service which have built up the customary textile mill practice of buying motors and drives from electrical motor shops are threatened by minor procedural details. A bonanza of motor and drive business is reaching machinery dealers who have never before been an important factor in their sale or distribution.

As soon as WPB has a chance to work out a correction of this wholly unintentional discrimination, the

chances are that we shall have prompt relief. However, it should serve as a warning that, with so many normal economic factors dormant, a few words in a government regulation can force new lines of distribution which have never stood the test of normal competition. Important and far reaching discrimination by procedures during the transition period is an ever present threat. The danger can be minimized only by constant vigilance.

See Your Contractor

It is gratifying to note that two large companies whose advertising reaches thousands of readers are giving the electrical contractor strong support in their advertising copy.

A Graybar ad asks the architect to "talk tools" with the contractor, emphasizing the importance of the contractors' tools, equipment and modern methods, in electrical installation work. An Anaconda ad discussing the post-war electrical home says wiring has to come first, and asks the reader to talk to his electrical contractor for ideas.

We should be quick to commend such direct support. It publicly recognizes and strengthens the hands of contractors trying to do a quality selling job. It gives concrete evidence of a sound and forthright distribution policy. And it represents strong constructive industry cooperation.

New Subscribers Now Have To Wait

There are approximately 1200 new subscribers waiting in line for this issue of *Electrical Contracting* that we shall not be able to serve. We don't like it. But with paper restrictions we must hold our circulation at a fixed number adding new subscribers when we can.

Unfortunately there are some old customers of long standing in that line-up. They forgot to renew their subscriptions. We want your help to avoid that situation which we don't like any better than you do. Please don't wait until the last minute to renew.

During a period of sixty days before expiration of your subscription you receive four notices. Renewing on any one automatically assures the continuity of your subscription. Your copy is reserved and whatever further restrictions may be necessary you will continue to receive every issue. This is the best way we know to give our regular readers a preferred position.

But we need your help and cooperation. If you are a subscriber of long standing, renew at the economical three year rate. And please answer your renewal notice promptly.

High Voltage Adds Responsibility

Wartime copper shortage has sharply accelerated the design and installation of high voltage industrial distribution systems. While distribution at higher than utilization voltages in industrial plants is nothing new, it was rarely encountered before the war. Now it is fairly common, and out of the experience with war plant systems contractors have developed a know-how and specialized skill with interior high tension work that promises a continuation of high voltage distribution designs even when copper again becomes plentiful.

Two important factors in distribution system design are receiving more attention today than ever before; the rapid growth in industrial loads and the need for closely regulated lighting voltages. And high voltage distribution systems provide a practical and economical method in many cases to solve voltage loss and voltage fluctuation problems.

High voltage substations of unit

construction for inside use are well known today. With high voltage distribution they afford short secondary runs from load centers. Extensive lighting loads are being served from high voltage lines through small, air-cooled transformers located at the lighting circuit panelboards. And familiarity with transformer adaptation is opening the way to more frequent use of special voltages where they are desirable.

As voltages rise, however, the responsibility for highly skilled layout and workmanship becomes increasingly important. And nothing short of top quality materials can be considered. The increased use of high voltages and the consequent responsibility on the contractor for a high order of skill and safety protection can have a strong stabilizing effect on the whole industry and may tend to raise all standards of performance and safety.

Polarity In Question

Way back in elementary physics we learned that an electric current flows from positive to negative. And from elementary physics to elaborate system design the terminology of electricity consistently follows the plus to minus rule. Up until the advent of electronics, it did not make much difference what the assumed direction of flow was so long as we were thoroughly consistent in holding to one rule.

Electron tubes demonstrated that electron flow was from a negative cathode to a positive anode. The established positive to negative hypothesis did not fit the observed facts. But again it was not especially important so long as electronics stayed apart from the power and light and electrochemical field. Electronic engineers could talk in terms of electron flow and ignore the standard terminology of current flow entirely.

Industrial electronics and the common use of electronic devices as circuit elements in electrical apparatus brings the problem right to our door step. An irresistible force in the fact of electron flow meets the immovable object in the form of the vast body of engineering and physical history, literature and established custom.

Practically, from the standpoint of application, installation and mainte-

nance of industrial electronic apparatus, it is best to continue the accepted electrical terminology. But one of these days the terminology of electrical engineering and electronics must be made consistent.

Rural Wiring Needs Quality

It seems almost axiomatic to planners that cheapness is the first consideration in all things for the farm. At one time the attitude was probably justified. Cash incomes were low. Farms on the average represented a depressed element of our total economy. But the economic condition of the farmer has changed. He has and will have cash to buy. And his desires were never more modest than the city dweller.

In wiring, appliances and electrical apparatus, as a matter of fact, the farmer's needs are far more elaborate. Farm wiring is more than comfort and convenience. It has to serve production machinery. It must serve refrigeration on the same level of reliability as a metropolitan store. It must serve water pumps and water heating, and feed grinders at the same grade of reliability as a factory compressor, glue pot or conveyor line.

Farm wiring is properly a challenge to quality and reliability standards. Price and low costs are important, but no more so than in any other broad wiring market. And as the farm market grows it is likely that we shall have more wiring, appliances and apparatus of special design to meet its special conditions. But the quality standards must be high.

Washington Notes

► Draft policy finally worked out between WPB and the armed forces will permit further extension of war industry deferments in the 21 to 26 year group to about 50,000 key men in high octane gas, synthetic rubber, radar and other new industries which have been built up on the high specialized skills of young men. Every effort is being made to keep up the schedule of induction and at the same time hold down the average age. Draft schedules will

be maintained even at the risk of production delays.

► Public address and sound equipment will be made available to a limited number of industrial plants. Music for fatigue periods, time saving on paging personnel and reduced load on telephone lines are among the advantages to production expected.

► Demands of congressmen that labor unions report all financial affairs to their members is looked upon by labor leaders as baiting. The United Mine Workers, headed by John L. Lewis, has made a long and extremely detailed report to all its members for years. It arouses little interest outside the ranks. Tax threats are causing some worry, however, in union circles.

► Resumption of a limited production on domestic oil burners for replacement has been recommended by an industry committee. However, the supply of fractional horsepower motors is still critically scarce. Special efforts will be made to supply urgent maintenance and repair needs.

► A recent report of the National Housing Agency shows the total housing units completed under the war housing program since 1940 is 1,479,502. Since it takes about 400,000 homes a year just to keep even, the whole war housing program has hardly affected the postwar housing needs. Postwar housing is primarily a job for private enterprise and the responsibility for planning rests with the community according to John P. Blandford, Jr. of N.H.A. He predicts that a program of one to four and a half million homes a year over 10 to 20 years is a clearly attainable goal.

► Construction volume for December 1943 was \$345,347,000 or 14 percent under November. It consisted of \$92,373,000 military; \$97,474,000 industrial expansion; \$91,500,000 housing and \$67,000,000 all other construction. Industrial facilities (construction plus machinery and equipment) totalled \$221,896,000.

► If you have government contracts in excess of \$10,000, it is important to know the Walsh-Healey Public Contracts Act. A supplement has been issued recently. Copies may be obtained at regional offices or the National Office of the Wage Hour and Public Contract Divisions, 165 West 46th Street, New York 19, N. Y.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

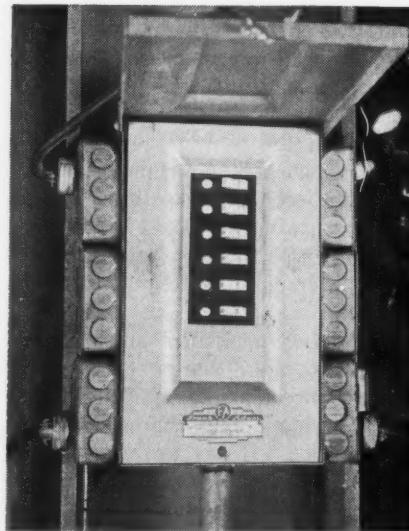
SHIPYARD USES GROUNDED RECEPTACLES

WIRING

Electrical systems in shipyards should be ultra-safe and is the theory followed by M. L. Levy, electrical engineer for Higgins Industries, Inc., New Orleans, La., shipbuilders. Consequently, he has insisted upon the installation of grounded receptacles throughout the plant—for use with electrical tools and extension lamps. Not only has he fostered the installation of grounded receptacles, but also overload protection for individual units.

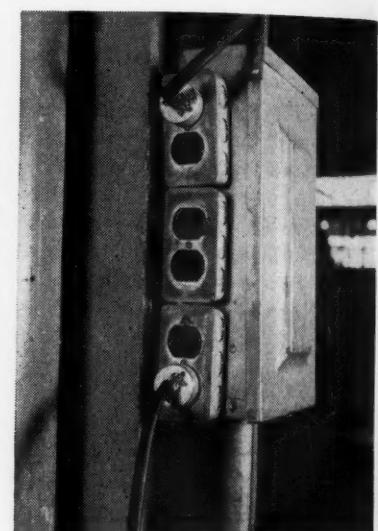
Inside the plant proper, ordinary duplex, three-wire, grounded, twist-lock receptacles are used. These are gang mounted on each side of a conventional circuit breaker panel which in turn is mounted in the web of the supporting building columns. One circuit breaker protects each duplex outlet. By using this system, each individual tool is protected and a short circuit on one will affect only the breaker on that outlet and not kill a number of outlets as in grouped circuits.

Outdoor convenience outlet stations are handled in the same manner, except



CIRCUIT BREAKER protection is provided for each duplex receptacle mounted on the panel. An ordinary load center does the trick. Tools are now protected from shore circuits and over loads.

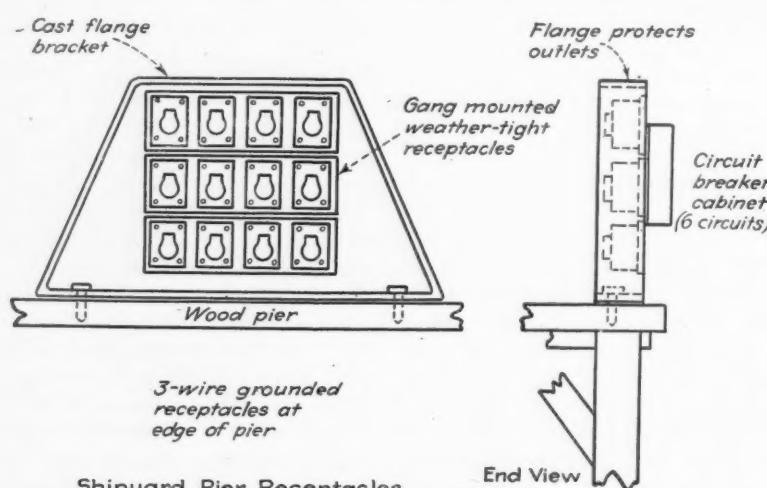
that the outlets are of the water-tight type. Wherever possible these panels are mounted on vertical supports or poles. However, down by the waterfront, where the ships go through their final fitting stage, the convenience outlets are installed at the edge and on the



GROUNDED RECEPTACLES of the duplex, twist-lock type are mounted on the sides of a circuit breaker panel for use with portable tools and lamps in indoor locations.

floor of the pier. In this instance, three rows of four-gang, weather-tight outlets (each with a single receptacle) are mounted in the web of a cast-iron bracket (trapeziform) whose flanges protect the outlets. On the back of this bracket (see diagram) is mounted a six-circuit circuit-breaker panel, each breaker protecting two of the three-wire, grounded twist-lock type receptacles. Tool and lamp extensions are plugged into these outlets and used on shipboard. By locating outlets at pier's edge, extension cords are kept out of the pier traffic aisle.

Grounded circuits for portable electric tools and hand lamps is particularly important for safety in shipyards where workmen are working on metal and in outdoor locations where wet surfaces may be encountered.



WATERFRONT RECEPTACLES, mounted on the floor of the pier, follow the design outlined above. Other weather-tight outlets are mounted on nearby poles, if feasible. Pier arrangement eliminates tripping over cords.

HIGH POWER FACTOR BOOSTS SYSTEM CAPACITY

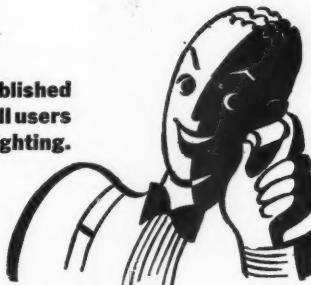
INDUSTRIAL

When the Tool Steel Gear and Pinion Company in Cincinnati, Ohio, began to seriously consider the power

Fluorescent operating hints

No. 1

of a series published by Sylvania for all users of fluorescent lighting.



HOW TO TEST LAMPS AND STARTERS

If a fluorescent lamp blinks or fails to light early in life, it does not necessarily indicate premature lamp failure. The trouble may be a defective ballast or a faulty starter. However, the first thing to do is to replace both the lamp and the starter with units known to be satisfactory. If the new lamp fails to operate with the new starter in place, loose connections in the wiring or ballast may be the reason, and the electrician should check the entire circuit.

To check the questionable lamp and starter that have been removed, test them in a fixture known to be performing properly, or return them to the maintenance shop for checking on a simply constructed test board.

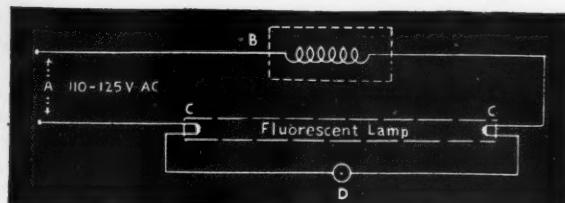


Figure 1

HOW TO MAKE TEST BOARD

Fig. 1 shows the wiring for a simple test board that can be used to check either lamps or starters. **A** is the connection to the 110-125 volt AC line. **B** is a single-lamp ballast of the same wattage rating as the lamp being tested in **C**, the lamp sockets. **D** is the starter socket.

DUMMY-STARTER TESTER

For use with this test board, you can make a dummy-starter tester from a spare or used Sylvania starter by removing the can and connecting the two contacts permanently, Fig. 2. Replace the can and scratch it with a



Fig. 2

distinctive mark, so that it will not be mistaken for one of your regular starters.

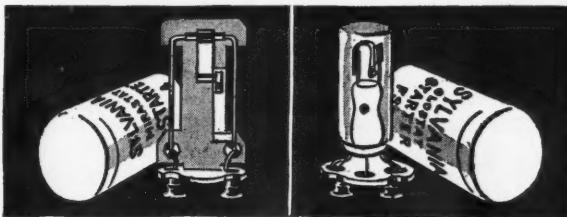
TESTING THE LAMP

Place the lamp to be tested in lamp sockets **C**, and place the dummy starter in socket **D**. If the lamp is good, both ends of it will glow when the dummy starter is in the socket; and the entire lamp will light when the dummy starter is quickly removed. If the lamp does not perform in this way, it is worn out and should be discarded.

HOW TO TEST STARTER

To test starters on the test board, put a lamp known to be good in sockets **C**, and put the questionable starter in socket **D**. If the starter is good, the lamp will light in less than 30 seconds.

(**CAUTION:** Test No. 2 starters with 15- or 20-watt lamps only; No. 4 starters with 30- or 40-watt lamps only; No. 5 starters with 6- and 8-watt lamps only; No. 6 starters with 100-watt lamps only; and No. 7 starters with 65-watt lamps only.)



MIRASTAT—Sylvania's thermal-type starter

GLOSTAT—Sylvania's glow-type starter

STARTERS ARE LAMP-LIFE INSURANCE

The fluorescent lamp starter is an automatic time-delay switch. Mechanically rugged, it enables the fluorescent lamp to establish its lighting arc without the use of high voltage.

Starters cost only a few cents — but they protect your really important investment in fluorescent fixtures and fluorescent lamps. Defective starters shorten lamp life and cause overheating in ballasts. It pays to test your starters and replace defective ones with Sylvania Mirastats or Glostats.

For Additional
Maintenance Information

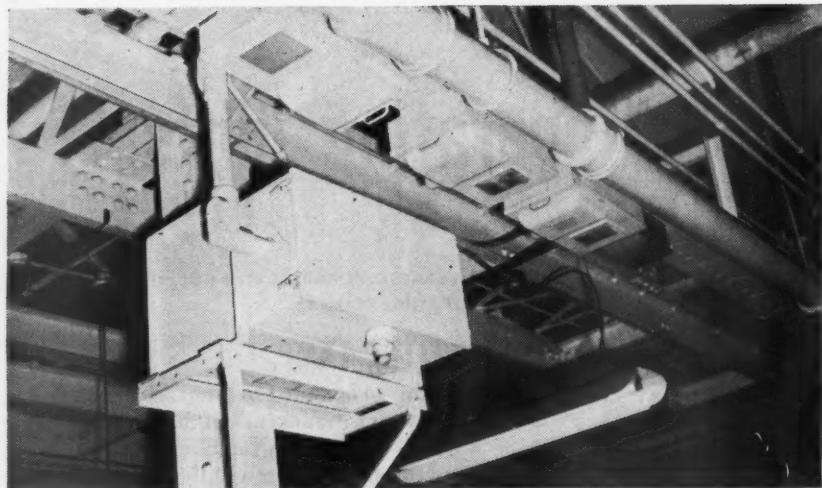
Send for this Free Booklet



SYLVANIA ELECTRIC PRODUCTS INC.

SALEM, MASS.

INCANDESCENT LAMPS, FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES



BUILDER UPPER in the form of a 30 kva. bank of capacitors gives this industrial plant feeder duct that extra margin of capacity needed to carry its wartime load.

factor condition of their electrical system, they had a two-fold purpose in mind: first, to get the most out of their purchased power (most utilities have a low power factor penalty clause in their contracts); and second, to increase the carrying capacity of their electrical system without using additional critical materials.

The first step taken by Ray Stroppel, maintenance engineer, was to make a comprehensive survey of the entire plant electrical system. This included:

1. A careful study of the power demand, peak loads, rates and other pertinent data.

2. Extensive recorded tests on all motors to assure against overmotoring and the resultant inefficient and low power factor operation.

3. Recommendation of use of high speed motors wherever possible to hold up power factor and reduce floor space required for motor mountings.

4. Adjusting the synchronous motors on two air compressors to lead as far ahead as the excitation nameplate ampere rating would permit. Over-excitation was avoided because the gain in leading current would not be worth the chance of running into trouble.

5. The use of capacitor banks to boost the overall system power factor to the desired level. This final step was taken after the average non-controlled power factor condition of the system was determined.

Step No. 5, in this particular plant, meant the installation of a total of 120 kva. of capacitors. This total was divided into four 30 kva. banks, each containing four $7\frac{1}{2}$ kva. units mounted at the end of feeder runs. The banks, in general, rested on an angle iron platform bolted to the steel building columns. Conduit connections from the capacitor pull box to the duct were made through a 200-amp., externally operated, fused disconnect switch plugged into the duct openings.

An added feature was the installation of a pilot light on the pull box of each bank of units. This light is connected across one phase of the load side of the disconnect switch. When the capacitor is on the line the light burns continuously. If it is out, it means that the switch has been left in the "off" position and the unit is not in service.

Before correction, the plant power factor was about 79 percent. Within a period of a year after corrective measures were applied, the overall system power factor averaged between 85 and 88 percent. Also, one of the corrected feeders, originally designed for spare capacity, may be able to serve a plant extension. This would eliminate the necessity of installing a new oil switch and a 400-ft., three-phase, 500,000 CM circuit in $3\frac{1}{2}$ -inch conduit—a considerable saving of critical materials and equipment.

SECTIONALIZED SWITCHING FOR SAFETY

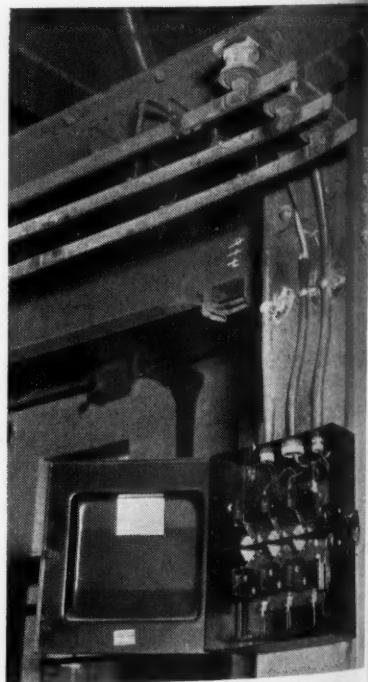
—INDUSTRIAL

Hazardous locations which endanger the life and limb of the employee must be eliminated from the industrial picture. The obligation is that of the plant engineer or contractor responsible for the original design and installation. The one obstacle to such a safety campaign is the old question of determining whether a particular location is hazardous or not. The best solution is not to give the human element the benefit of any doubt. If there is any possibility whatsoever that an employee, through slight carelessness or through the occurrence of the unexpected, might become seriously injured, then by all means install some sort of protection for him.

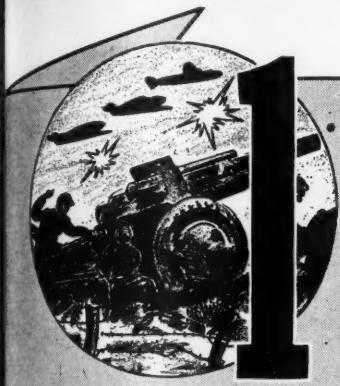
The Norton Company of Worcester,

Mass., manufacturers of abrasive wheels and grinding equipment, use 440 volt distribution throughout their entire plant. In the grain storage building, the three long bays on the ground floor are used for collecting, measuring and mixing the various abrasive grains. The collecting is facilitated either by a crane which runs the full length of the building and may be transferred from bay to bay at the far end by a transfer crane, or it may be collected by operators from the floor who collect the grain in kegs. When done manually, the operator uses a long metal stick for opening the chutes and starting the flow of grain. If the operator should be a little careless, his metal stick might easily come in contact with the exposed 440 volt 3 phase trolley that supplies the crane.

To circumvent this possibility, the trolley bus has been broken up into 50-foot sections with a double throw switch supplying each section. In the up position, the rocker blades which are connected to the load, make contact with the line terminals. In the down position, they make contact with ground. The three lower terminals are all shunted directly to the building steel which presents a good solid ground. In addition, a small contactor was installed in the switch box that would operate two green lights, one at each



TROLLEY BUS OF 440 VOLTS is sectionalized and grounded by double throw switches such as this. To the right of the lower right hand arc chute can be seen the signal-light contactor which is actuated by the knife blade cross-bar. Green signal lights are lit at each end of the sectionalized trolley to denote that it has been de-energized and grounded. Note how the lower terminals are jumpered to ground.



... for Victory

USE PORCELAIN PROTECTED WIRING SYSTEMS TO HELP IN THE CRITICAL MATERIAL CONSERVATION PROGRAM . . .



... for good business and better customer relations

GET THE BENEFITS TO YOURSELF AND CUSTOMERS THAT PORCELAIN MAKES POSSIBLE

PORCELAIN *Protected* WIRING SYSTEMS

Quick installations are accomplished—economical results are realized—complete insulation and protection from the entrance switch to the very last outlet on the system — short-proof and shock-proof qualities of porcelain contribute to dependability—rust and corrosion resistance characteristics make porcelain the ideal material in damp, wet, or dry locations — porcelain gives you permanency and adequacy.

PORCELAIN has taken its place as a "weapon of war." Its availability, its dependability, and its non-critical status gave American contractors the opportunity to proceed with wiring jobs of all kinds—industrial, commercial, and residential. At the same time that porcelain made possible war time wiring on a continuous scale it released rubber, steel, and other critical metals for fighting equipment.

PORCELAIN long ago proved the point that it was a natural for wiring—PORCELAIN will continue to be the simple way—the truly economical way—the way that assures permanence. Today's results in wiring with porcelain forecast its advantages both to contractor and customer for the future.

* ILLINOIS ELECTRIC PORCELAIN CO.

Macomb, Ill.

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East Liverpool, Ohio

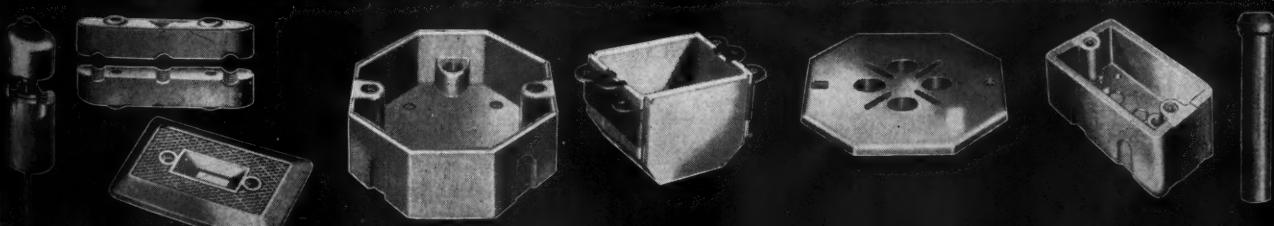
* SUPERIOR PORCELAIN COMPANY

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* UNIVERSAL CLAY PRODUCTS COMPANY

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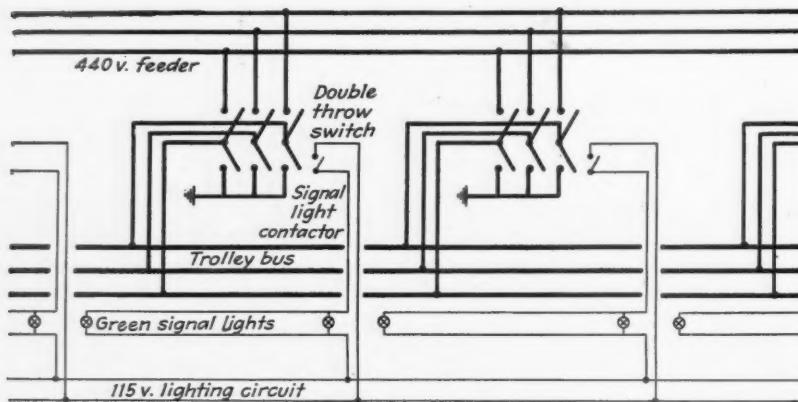
MODERN PORCELAIN PROTECTED WIRING SYSTEMS



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April 1944



SCHEMATIC WIRING DIAGRAM of the sectionalized trolley bus system. Double-throw switches are used to ground bus in case an operator must work on that particular area. Positive protection is provided by requiring lights to be "on" while system is safely grounded.

end of the sectionalized trolley bus. As the switch handle is thrown down into the grounded position, the knife blade connecting bar hits an extending arm of the signal-light contactor and lights the green bulbs.

Thus when an operator is to collect in any particular area with his metal stick, he is not to do so unless the green bulbs are lit. This gives the operator a positive means of protection; that is, if the bulbs are out he may not work in that area until he has investigated the circuit switch to ascertain whether the trolley is hot or if the bulb has burned out.

The cost of such "hazardous location" protective means is insignificant when compared with its safety value.

KNOWLEDGE OF CIRCUITS AIDS TROUBLE-SHOOTING D. C. CONTROL—NO. 1

By L. E. MARKLE*

Ease in shooting trouble on d.c. controls depends largely on a clear understanding of the basic principles and circuits used. It is the purpose of this series to give that information.

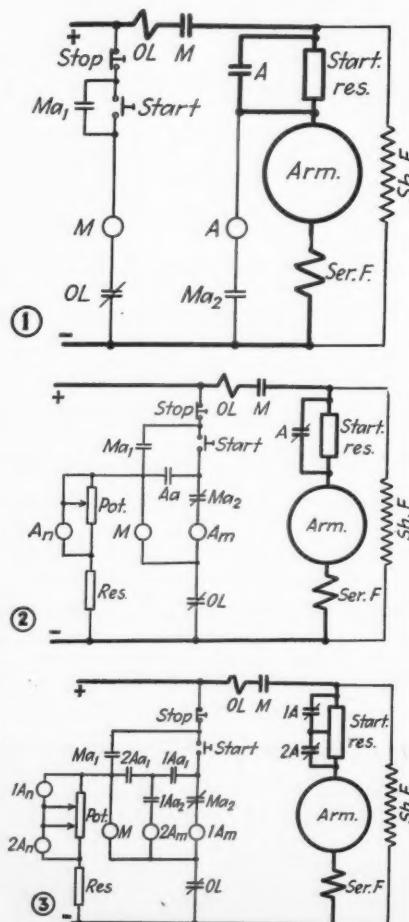
In general, d.c. motors of less than one-hp. rating can be started across the line, but with large motors it is usually necessary to put resistance in series with the armature when it is connected to the line. This resistance, which reduces the initial starting current to a point where the motor can commutate successfully, is shorted out in steps as the motor comes up to speed and the counter-voltage generated is sufficient to limit the current peaks to suitable values. Accelerating contactors that short out successive steps of starting

*Control Engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

resistance may be controlled by various methods. Two common methods are by countervoltage or by definite-time relays. For small motors used on auxiliary devices, the counter-emf. starter is satisfactory. The definite-time starter is more widely used, however, and has the advantage of being independent of load conditions.

The following diagrams illustrate some of the circuits commonly used for d.c. motor control.

Fig. 1 represents the basic requirements of a non-reversing d.c. starter in its simplest form. Pushing the start

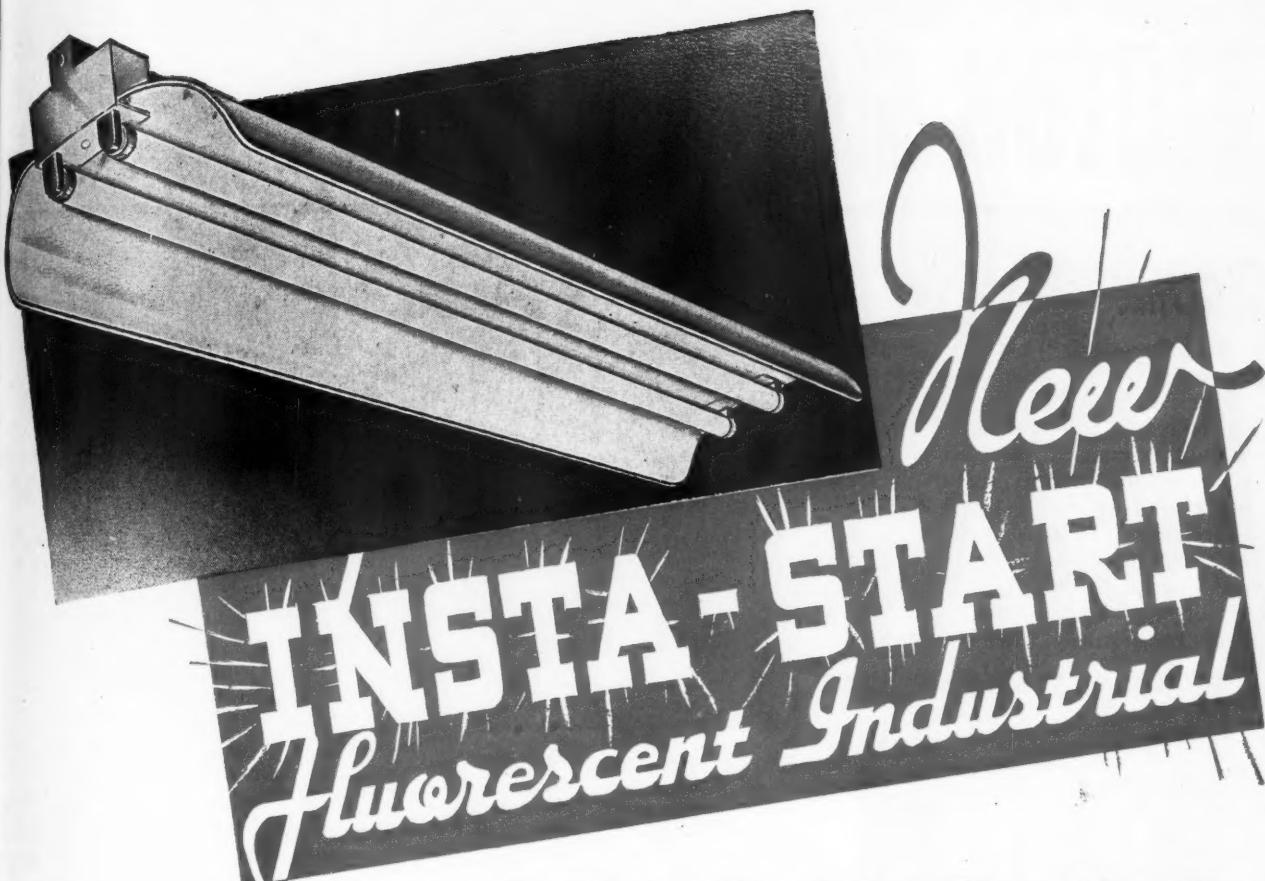


button energizes coil M, closes contact M, and auxiliary contacts Ma₁ and Ma₂. The closing of Ma₁ sets up a holding circuit when the start button is released. The closing of auxiliary contact Ma₂ places coil A across the armature and series field. As the motor comes up to speed the counter-voltage developed in the armature windings increases, and at some predetermined value of this counter-voltage, coil A becomes sufficiently energized to close contact A shorting-out the starting resistance. Contactor A is known as the accelerating contactor.

Fig. 2 typifies a non-reversing, constant-speed, definite-time starter. The accelerating contactor A is provided with a time-delay feature. This contactor A is of the magnetic-flux-decay type. It is spring-closed, equipped with two coils A_m and A_n, and has a magnetic circuit that retains enough magnetism to hold the contactor armature closed and the contacts open indefinitely. The main coil A_m has sufficient pull to pick-up the armature (when starting) and open contact A, whether A_n is energized or de-energized. Neutralizing coil A_n is connected for polarity opposite to the main coil A_m. A_n is not strong enough to affect the pick-up or holding ability of the main coil but, when A_m is de-energized, the neutralizing coil will buck the residual magnetism so that the contactor armature is released by the spring, and the contacts close. By adjusting the potentiometer across A_n, the voltage impressed on this coil, and hence the time required for the contactor to drop out and close contact A can be varied. When the start button is pressed, accelerating contactor coil A_m is energized opening contact A and closing auxiliary contact A_a. Contact A_a energizes coil M, closing contacts M and Ma₁, the latter establishing a holding circuit. Neutralizing coil A_n is also energized. At the same time Ma₂ opens, de-energizes coil A_m, and contactor A begins timing. At the predetermined instant (by potentiometer setting, neutralizing coil A_n having weakened the residual magnetism) the spring overpowers the magnetic attraction and releases the contactor armature to close contact A, short-circuiting the starting resistance.

Fig. 3 is the same type of starter as in Fig. 2 but designed for a motor of larger horsepower. This starter provides two steps of definite time starting. The operation is essentially the same as in Fig. 2. The normally-open auxiliary contacts of the accelerating contactors, (that is, 1A_a, 1A_a, and 2A_a in Fig. 3, and A_a in Fig. 2) are arranged so that it is necessary for the accelerating contactors to pick-

[Continued on page 162]



INSTA-START OUTSTANDING 50-A-SERIES FEATURE . . .

- 1 It's easier to install with this new rigid simplified construction.
- 2 Entire wireway and ends may be exposed quickly, without taking fixture down.
- 3 May be surface-chain or stem mounted singly or in continuous runs.
- 4 Exposed ballast gives longer life and cooler operation. Inverted under channel.
- 5 Special K.O. for wall switch is provided in lamp holder cover.
- 6 Complies with all W.P.B. and U. S. Bureau of Standard regulations.
- 7 Reflectors of masonite—formed and finished under exacting specifications in our own plant.
- 8 Underwriters' Laboratories approved equipment used in all these fixtures.
- 9 Union Made—International Brotherhood of Electrical Workers, A. F. of L. Bear their label.

**Instant-Positive Starting has
No Starter Switches . . . Starts
at 0° Temperature . . . Starts at
Lower Voltages . . .**

This new super-powered lighting unit operates standard 40 watt and 100 watt Fluorescent Lamps. Its insta-start ballast is made and guaranteed for a full year by a leading manufacturer of electrical transformers.

Insta-start units reduce maintenance by the elimination of starter switches. Turns on and off like an incandescent lighting fixture.

Will operate as low as 85 volts, which is important in plants where load capacities are a problem.

Insta-start units will operate at zero temperatures. Lamps will not blow-out in cold drafts.

Investigate this new Fluorescent Insta-start lighting unit today. Obtainable for immediate delivery.

Open and Closed Type Commercials

A new outstanding line of L. P. I. Commercials, ideally suited for drafting room, office or other essential locations, is now available with either Conventional or Insta-Start Ballasts. Write today for bulletins describing these new fixtures!

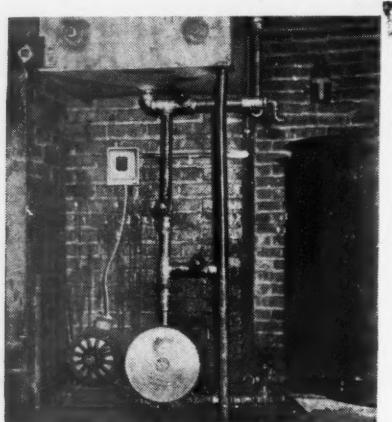
LIGHTING PRODUCTS INC. HIGHLAND PARK • ILLINOIS

MOTOR SHOPS

STORAGE TANKS FOR INSULATING VARNISH

To prevent oxidation of his insulating varnish, W. W. Hanks of Southern Electric Service Co., Charlotte, N. C. has built a storage tank into which the varnish is pumped after using. The large square tank is bolted to the walls in a corner up off the floor, and supported by a steel pipe as shown in the photograph.

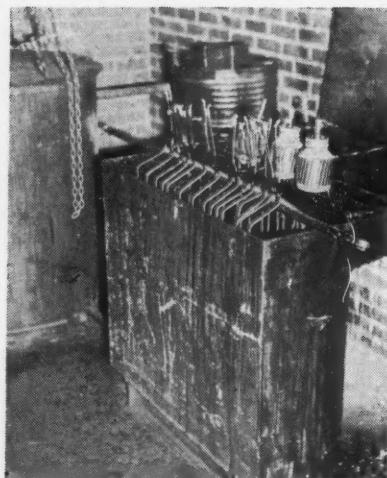
An ordinary hand circulating pump (utility type used to pump oil up into pole transformer tanks) has been



CIRCULATING PUMP is located behind the solid chain-driven sprocket. Storage tank is supported at one corner by a length of pipe. Large dip tank is seen on right.

adapted to motor drive with two outboard bearings and a large disc sprocket. The piping system can be seen in the accompanying photograph. It utilizes five valves. The two valves on the floor each feed a dipping tank. The first valve above the sprocket is a by-pass valve for feeding varnish from the storage tank to the dipping tanks. The second valve above the sprocket is the main line valve.

In addition to the large dip tank, a smaller, cleverly built tank is used for smaller equipment. It is built in an angle shape of welded sheet-steel construction. The main portion of the tank is in front for easy dipping. The drain table extends back and is provided with a tapering bottom to drain the varnish back into the tank. The drain board is also provided with a grate type rack on which armatures, small stators and the like can set while draining. This tank is also attached to the piping system so that the varnish may be pumped out after using.



SMALL DIP TANK is provided with drain board which salvages dripping varnish while other dipping continues. Large dipping tank is seen in left background, above which is mounted storage tank.

OVEN STARTING OUTLINED ON BOARD

Operating the huge Despatch gas fired bake oven at the motor service department of Industrial Electric, Inc., New Orleans, is made easy by an out-

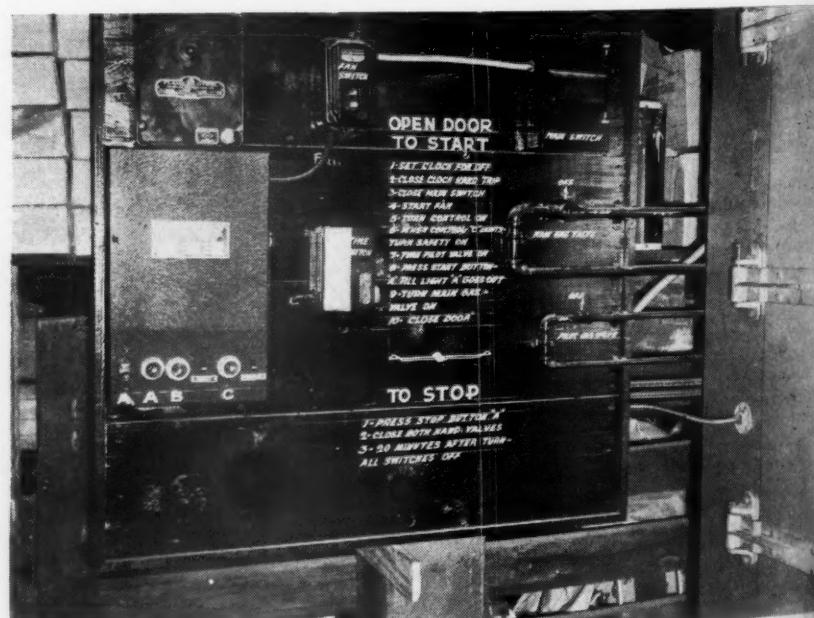
line of the sequence starting steps, painted on a large control board directly in front of the oven. Instead of crowding all control equipment in the smallest available space and mounting it in a corner, Industrial has taken the time and space to spread out the equipment and clearly label it so it is accessible and can be readily identified.

One reason is that the control circuits are so arranged that the oven can be started only when the various steps are followed in the proper sequence. Another is—that with this set up, anyone in the shop can operate the oven if the instructions are followed. There is no hunting for a misplaced instruction sheet—everything is printed right out in front of the operator.

The instructions, as painted on the center of the control board (merely a wooden backboard on which the equipment is mounted) are as follows:

OPEN DOOR TO START

1. Set clock for OFF.
2. Close clock hand trip.
3. Close main switch.
4. Start fan.
5. Turn control ON.
6. When control "C" lights, turn safety on.
7. Turn pilot valve on.



INSTRUCTION BOARD with controls mounted thereon gives mechanics in this New Orleans motor shop the whole story of bake oven operation at a glance. Sequence starting must be followed for proper oven operation.

**SQUARE D
Positive Pressure
FUSE CLIPS**



**MEET HIGH SHOCK REQUIREMENTS FOR USE
WITHOUT AUXILIARY FUSE-RETAINING GADGETS**

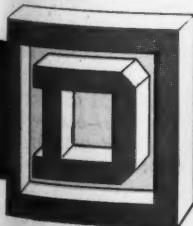
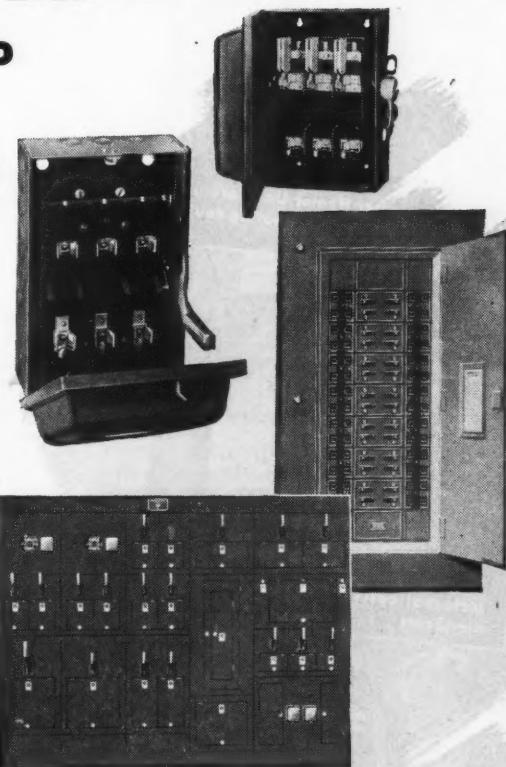
**STANDARD FEATURE IN ALL SQUARE D
SWITCHES, PANELBOARDS AND
SWITCHBOARDS FOR 30-60 AMPERES**

In spite of the tremendous shock of the big guns on fighting ships, the Navy accepts these clips without auxiliary fuse retainers. The powerful gripping force of the built-in steel spring does the job.

This, plus the fact that Square D Positive Pressure Fuse Clips are copper instead of the usual bronze, means (1) higher conductivity and (2) up to 60% heat reduction at the point of contact between clip and fuse ferrule. Yet fuses may be quickly and easily removed and replaced without fuse pullers or other "trick" devices.

The same basic principle is also used in all Square D fuse clips from 100 to 600 amperes, providing the same positive contact and reduced heating. The positive pressure feature is entirely automatic, requiring no bolts or clamps which loosen under vibration, shock or the wearing of threads.

Pressure fuse clips are just one of the many reasons Square D is preferred for marine applications.



ELECTRICAL EQUIPMENT

KOLLMAN AIRCRAFT INSTRUMENTS

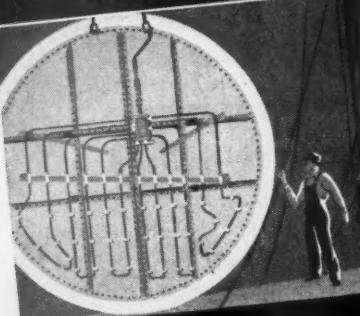
SQUARE D COMPANY

DETROIT

MILWAUKEE

LOS ANGELES

CUTLER-HAMMER ELECTRIC HEATERS
HAVE SOLVED THESE PROBLEMS—
AND HUNDREDS MORE



Cutler-Hammer Heaters keep dam roller gates free of ice.



Cutler-Hammer Heaters keep dies hot in embossing presses.



Cutler-Hammer Heater Units are used in many types of better heating devices



Cutler-Hammer Heaters provide clean, automatically controlled heat for sterilizers



Cutler-Hammer Heaters simplify thread waxing in shoe stitching machines.

Cutler-Hammer Heaters keep incubators at a safe, even temperature.

Heres How

YOU CAN SOLVE THAT SPECIAL HEATING PROBLEM

Do you want to heat the cab of a traveling crane . . . or an isolated watchman's hut . . . or a corner in some loft? Do you want to "spot heat" a moving member in a special machine, or a plastic press, or a folding machine, a glue cooker or a shoe stitcher or a warming oven? Do you want heat that you can turn on and off at the touch of a button? Then you will be interested in Cutler-Hammer Electric Heat, tool of a thousand uses, capable of being shaped, applied and controlled in more ways than perhaps you ever thought possible. You may also be interested in the judgment of plant executives and machine designers who know the importance of the correct, efficient and economical solution of such heating problems. They have found that Cutler-Hammer's specialized knowledge in this field, dating from 1910, has been directly instrumental in securing to them the utmost advantages of the electric heating method. Why not write Cutler-Hammer today for details of Cutler-Hammer Electric Heat? CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ont.



Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves

CUTLER-HAMMER
ELECTRIC HEAT
C-H



8. Press start button "A" until light "A" goes out.
9. Turn main gas valve on.
10. Close door.

TO STOP

1. Press stop button "A".
2. Close both hand valves.
3. 20 minutes after—turn all switches OFF.

All lettering, including switch and control identification, is in white on a black background. Gas piping with control valves is purposely extended to the control board for accessibility. A duplex convenience outlet is mounted on the board for use with electric tools or hand light extensions for oven maintenance and repairs.

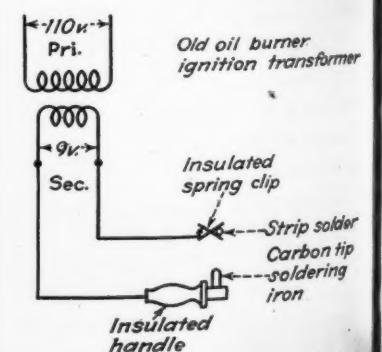
It takes time and effort to do so thorough a job but, with a skilled manpower shortage and the need for training inexperienced help, it pays dividends in the elimination of errors, misunderstanding and the resultant possible damage to equipment.

QUICK-HEAT SOLDERING DEVICE

A time saving method of soldering coil connections on small motors was recently developed in the shop of the Koepp Electric Motor Company, Manitowoc, Wisconsin. Minutes have been reduced to seconds with the use of this unique electric soldering iron.

The heart of the device is an old oil burner ignition transformer with a single phase 110-volt primary and a nine-volt secondary. One leg of the transformer secondary terminates in an insulated spring clip designed to hold ordinary strip solder. The other leg terminates in a carbon tipped soldering iron (see accompanying diagram).

Touching the solder with the right-angle tip of the iron completes the secondary circuit, causing the current to flow and melt the solder. In actual use, the solder is placed on the pigtail coil connection, then the tip of the iron is



SCHEMATIC DIAGRAM showing the simple circuit of the quick-heat soldering device developed and used by the Koepp Electric Motor Company.



Hot arcs stopped Cold!



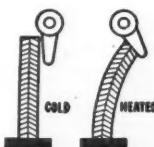
A circuit breaker must work fast... pass harmless overloads without interruption... yet when danger threatens, it must open the circuit and quench the arc—quick!

Westinghouse "De-ion" Circuit Breakers do this—and protect themselves, too—burns and pits are minimized, contacts last longer.

To restore service instantly, once the disturbance is cleared, simply flip the indicating handle. No waiting—no repairs—no parts to replace.

Protect equipment and circuits with Westinghouse "De-ion" Circuit Breakers. Ratings up to 600 amperes; enclosures for nearly every type of service. Call your Westinghouse Representative today. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-21297



DEFENDING THE CIRCUIT is the job of this Westinghouse Bi-metal element. Two metals which react differently to heat are bonded together. Threatening overloads cause the Bi-metal to bend, tripping the interrupting mechanism and opening the circuit—before any damage is done.



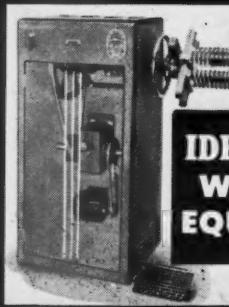
STOPPING ARCS COLD is the task of the "De-ion" arc quencher... consisting of parallel metal plates in the form of a grid. It draws the arc into the quenching chamber, divides it into segments... smothers it between the plates... in the space of a half cycle.

Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

"DE-ION" CIRCUIT BREAKERS



Accurate - Uniform - Automatic!



IDEAL COIL WINDING EQUIPMENT

Coil Winder Drive

Assures uniformly wound, perfect coils. Speed is infinitely variable from 90 to 500 RPM; Automatic Counter accurately shows number of turns. Output torque 350 to 60 inch lbs. depending upon speed.

FOR USE WITH ALL TYPES OF COILS AND ARMATURES

IDEAL COIL WINDER HEADS



IDEAL ARMATURE WINDING HEAD



Adjustable to accommodate armatures up to 3" in diameter with 2½" maximum armature stack. Easy to set up.

IDEAL INSULATION TESTER



Quickly indicates the presence of "shorts," "grounds" or broken wires in low-voltage equipment, such as motors, transformers, etc.

Write for Detailed Information

IDEAL Sycamore
IDEAL COMMUTATOR DRESSER CO.

1041 Park Ave., Sycamore, Ill.
Sales Offices in All Principal Cities
In Canada: Irving Smith, Ltd., Montreal, Quebec

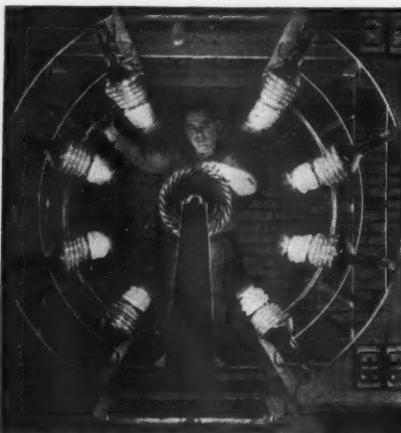
applied and the solder flowed over the connection. A disconnect switch operates the transformer.

Considerable time is saved by having the current flow through the solder itself, compared to the conventional method of using an ordinary soldering iron which must first heat the solder before actually melting it. The device has been used successfully by the Koepp shop on various sized motor repairs enabling them to get out better jobs in less time.

RADIANT HEAT SPEEDS ARMATURE REPAIRS

Insulating varnish on rewound armatures is dried in one-half to one-third the time by the use of infra-red lamps. An 18-inch armature requiring 30 hours in the convection oven is baked in eight hours under infra-red.

First cost and installation time were reduced by using the original brick oven. The old doors were removed, the roof ventilated, and the two banks of lamps suspended on barn door hangers. Each bank of 60 lamps consists of



ARMATURE BAKING TIME is reduced two thirds with radiant heat lamps as compared with steam convection oven. This oven is arranged in three sections with controls to permit the baking of one, two or three armatures at one time. Armatures are baked during the night, utilizing off-peak power by controlling the circuit with an automatic time clock.

four rows mounted in a semi-circle, with a 27-inch radius. The barn door hangers permit moving the banks in or out to place them at the proper distance from the armature surface.

Each group of five lamps is controlled by a 20 ampere safety switch. Twenty-four such switches provide maximum flexibility of control. The lamps are in three groups of five, 15 inches apart, to bake out three armatures simultaneously. The power supply is single phase, three-wire, and the total load is 30 kw. A total of 120 Westinghouse lamps are used, and rated at 250 watts each.

[Continued on page 169]

Make WIRE JOINTS

The MODERN WAY

with IDEAL



Solderless, Tapeless Wire Connectors

1. Strip wires
2. Screw on

NO RESTRICTIONS

Conserve Critical Materials . . . Ideal "Wire-Nuts" use no Tin or Rubber. Meet all Government Requirements and are approved as alternate for solder-and-tape joints. Listed by Underwriters' Laboratories, Inc. Sizes for every job. FREE SAMPLES.

If Your Electrical Jobber Hasn't
a Supply Write or Wire, Men-
tioning Jobber's Name.

Other Top-Quality WIRING DEVICES

- Fish Tape Reels and Pullers
- Wire Strippers
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- BX Armor Cutter
- Cable Ripper
- Test Lights

Sold Through Jobbers

IDEAL Sycamore
IDEAL COMMUTATOR DRESSER CO.

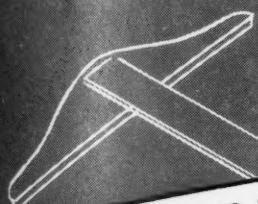
1041 Park Ave. Sycamore, Ill.
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NEW O. Z. FITTINGS

that fit into

PRACTICAL PLANS

Tested in the crucible of wartime service, these 11 additions to more than 160 O. Z. electrical fittings are ready to serve Practical Planners who recognize skilled engineering, modern manufacturing, and select materials. 25 years of close association with the electrical industries assures their use of O. Z. products.



INSULATED BUSHING FOR E.M.T.

An added bushing adapted for use with thin wall conduit (E.M.T.). Made of malleable iron with case-hardened cup point set screws. Insulation is molded and locked into the casting.



GROUNDING NIPPLE

A corrosion-resistant fitting with mechanical connection which is particularly adaptable for joining a ground wire to a conduit or a bank of conduits, and for other grounding purposes.



EXPANSION FITTING

A new, short, compact expansion fitting that compensates for expansion and contraction in a line of conduit. Composed of fewer parts, it takes a minimum of space and installation time.



THIN WALL EXPANSION FITTING

Incorporates all the features of the above fitting. Because of its special construction, the "TX" is supplied complete with extension nipples, ready to receive thin wall couplings.



T-CONNECTOR

A compact flexible fitting with two or three wire branch taps. O. Z. Interlocking Clamp insures positive gripping of wires. Of high copper alloy for full conductivity and corrosion-resistance.

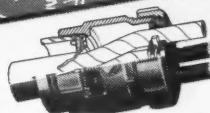
GROUND CONNECTORS

The new Interlocking Clamp has been incorporated in the completely redesigned line of O. Z. Grounding Devices. This feature confines the strands within the pressure area.



NEW HORIZONTAL TERMINATORS

All the features of the O. Z. Terminating Potheads are embodied in these Terminators, intended for use on conduit in inverted or horizontal installations.



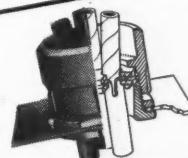
NEW "J" TERMINATOR

Incorporates the general principles of O. Z. Terminators, with the addition of a collapsible feature, making an easily installed device for terminating and sealing or as a pulling and splicing chamber.



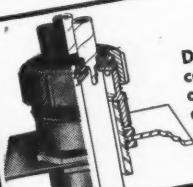
COMPOUND BUSHING

A compact sealing device used in locations where space is limited. This fitting is not equipped with a cover, and a small reservoir is provided for compound.



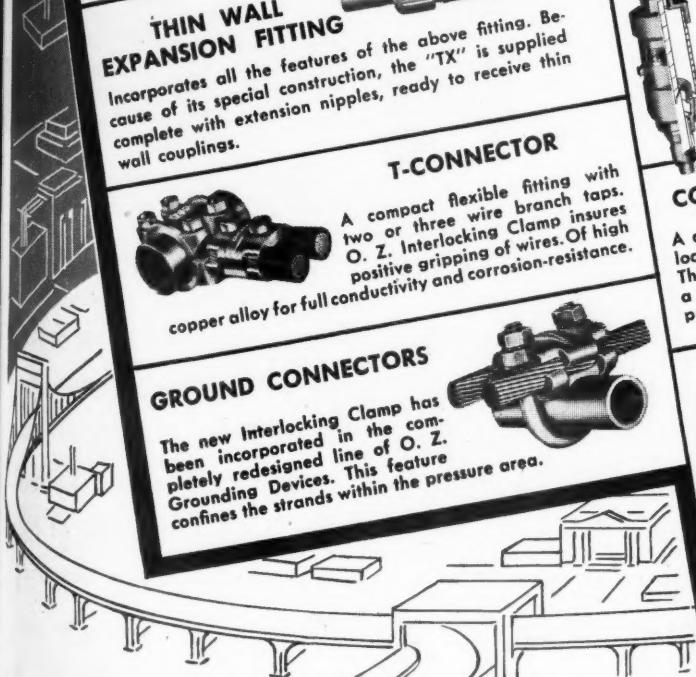
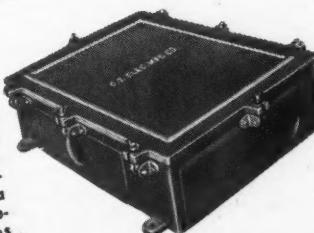
SEALING BUSHING

Developed to terminate and seal cables in cabinets, control boxes and other junction positions. Having no compound chamber its height is reduced allowing maximum space for other equipment.



NEW JUNCTION BOX LINE

A complete line of cast iron boxes has been designed in both flush and surface types for a wide variety of applications. Boxes of any type or size are readily supplied.



New 144 page, fact packed O. Z. Catalog covers the complete line of O. Z. products. Price lists, engineering data, and dimensions on Conduit Fittings • Cable Terminators • Junction Boxes • Solder-less Connectors • Power Connectors • Grounding Devices. Write for your free copy.



O.Z. ELECTRICAL MFG. CO.
262 BOND STREET • BROOKLYN 2, N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

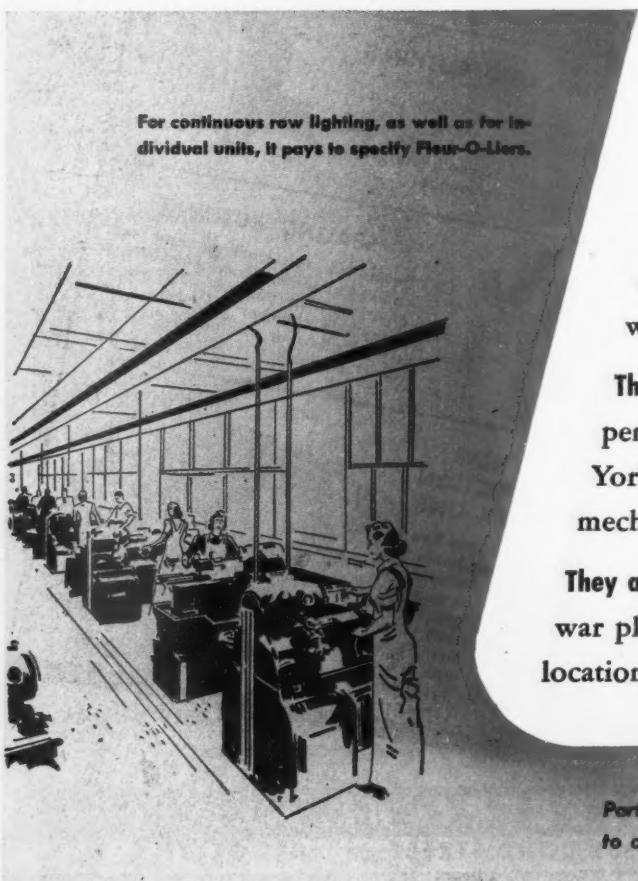
Protection-Service

Get all three with
FLEUR-O-LIER

Fleur-O-Liers are equally desirable in the office, factory or store.



**Want to get the most
from fluorescent lighting?**



For continuous row lighting, as well as for individual units, it pays to specify Fleur-O-Liers.

Then remember these important facts:

Certified Fleur-O-Liers are fluorescent lighting fixtures made by many leading fixture manufacturers in a wide variety of sizes and designs.

They have been tested, checked and Certified by independent experts, Electrical Testing Laboratories of New York, as meeting 50 definite standards for electrical, mechanical and lighting excellence.

They are available in industrial and commercial types for war plants, offices, drafting rooms and other war essential locations. (Priorities A-1-j or higher.)

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements.

Service-Dependability



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FOR THIS LABEL
WHEN YOU BUY

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The quickest way to make sure your customers get the protection, dependability, and service they need and want is to sell them fixtures wearing the famous Fleur-O-Lier label.

Performance—PLUS! FLEUR-O-LIERS combine the best features of prewar equipment and with new improvements developed to help the war effort. And, of course, all manufacturers of FLEUR-O-LIER fixtures conform to WPB limitations in the use of critical materials.

How Certified Ballasts and Starters help you

- longer fluorescent lamp life
- greater lighting efficiency
- full use of your wiring system
- dependable service

Get this Book

NEW! Write today for new booklet containing complete FLEUR-O-LIER engineering specifications, together with the FLEUR-O-LIER story and list of manufacturers. Fleur-O-Lier Manufacturers, 2122-4 Keith Building, Cleveland 15, Ohio.



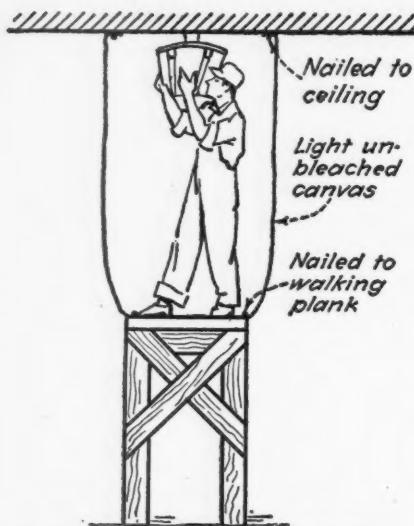
FLEUR-O-LIER

CERTIFIED FIXTURES FOR
FLUORESCENT LIGHTING

MODERN LIGHTING

CANVAS PROTECTS MACHINES DURING INSTALLATION

Robinson Electric Co. of Charlotte, N. C., who are lighting engineers and contractors specializing in commercial and industrial installations spent several years in selling a relighting job to the Southern Asbestos Co., also of Charlotte. Their efforts seemed to be in vain until one day they found out that the reason for past negative responses was that the customer could not afford to shutdown the various plant areas for rewiring the lighting circuits and converting to fluorescent. Nor could the work proceed while ma-



LIGHT UNBLEACHED CANVAS is nailed to the ceiling forming a tunnel for the men to work in. This catch-all protected valuable machinery from falling objects.

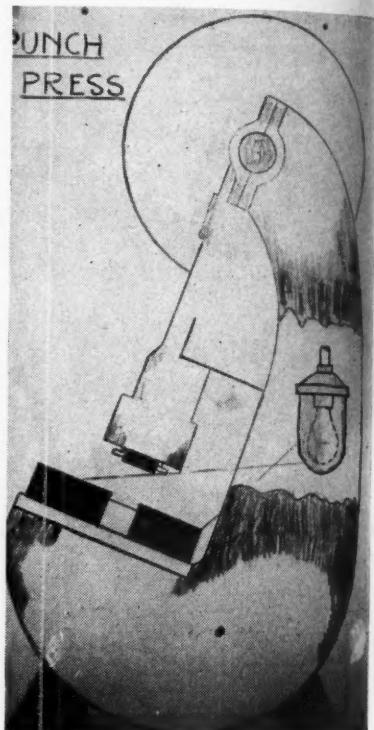
chines were running, for should the tiniest bolt, screw or washer fall into one of the machines, it would be wrecked and the machines were worth around \$20,000 each.

Roy Robinson guaranteed to do the job without a mishap and got the contract immediately. To insure against dropping tools, wiring material or miscellaneous items, he purchased a large roll of light unbleached canvas 12 feet wide and 60 feet long. Scaffolding four feet high and 60 feet long was then erected across the areas where work was to be done, and the machines were so spaced that scaffolding support could be provided every 12 feet. The canvas was then nailed tight against

the ceiling as in the accompanying diagram and work was carried on within this canvas tunnel. As soon as the wiring was completed, fixtures hung and lamps inserted, the catch-all equipment was moved on down the line.

The old installation consisted of 150 watt RLM units mounted on 16-foot centers. This was replaced by fluorescent, continuous strip, two 40-watt tube units. Mounting heights varied from 8 to 12 feet and center distances of continuous strip rows varied from 9 to 16 feet.

Installation specifications varied not only to suit illumination requirements of the different operations, but also because of the tremendous amount of airduct work necessary for the asbestos dust collection. The relighted areas now measure between 45 and 50 foot-candles of maintained illumination.



LIGHTING FOR PUNCH AND FORMING PRESSES

A previous item on Specific Lighting for Sheet Metal Fabrication, based on data compiled by the Chicago Lighting Institute in cooperation with the local WPB office and presented by E. R. D'Olive, Illuminating Engineer, covered squaring shears, hand and power brakes. This, the second and final item in this group, will discuss specific lighting for punch and forming presses.

Punch and Forming Presses may be straight-sided, open-typed reclinable or closed back. The main problem in either case is to get light under and on the upper and lower elements of the die. Since the face of the die is specular or polished, it is best seen when imaging or mirroring a low brightness light source.

Illumination is also required to facilitate setting up punches and dies. Cases have been observed where as much as 75 foot-candles were measured four inches from the die while, because of shadow, less than two foot-candles were on the die itself.

By inclining the press, two purposes are served—punched pieces drop away rapidly to clear the dies and more light can be directed into the dies.

Better illumination of the die can be accomplished by finishing the inside

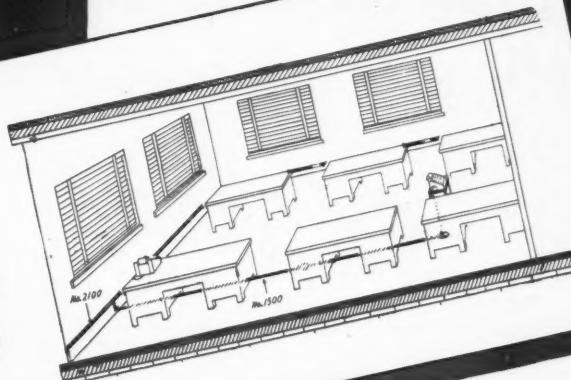
DIES ARE LIGHTED in this punch press by a 50-watt, mill type lamp in a diffusing Bell jar and guard. Unit, mounted between the side frames of the press, provides the low brightness source required for the specular dies.

surfaces of the frame in white or light color enamel or inserting porcelain enameled or stainless steel (depolished) reflectors. These easily cleaned surfaces are mirrored in the die faces and shoulders making them luminous. Another scheme is to install a 50-watt, mill-type lamp with a diffusing glass Bell jar in a wire guard mounted on a shockproof socket between the side frames. It should be mounted high enough and be baffled so as not to be in the eyes of the operator or any other worker within a reasonable distance of the machine. In any case, no bare lamps should be visible.

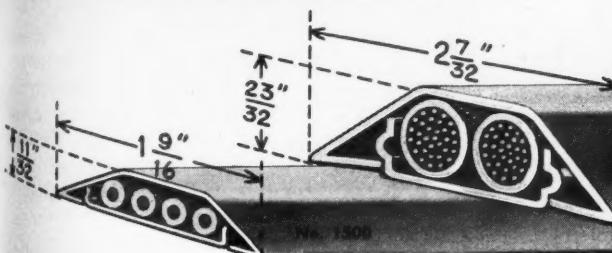
Another solution is the installation of a 6-inch diameter porcelain reflector with cover plate on a heavy arm with shockproof mounting. This assembly may be attached to the press or hung from above and should be directed to the die from the side or rear. Floor portables may be used either for intricate set-up jobs or production. Both incandescent and fluorescent portables are acceptable, although the latter are preferred.

the problem

*Telephone outlets
to desks in
factory + offices*



the answer



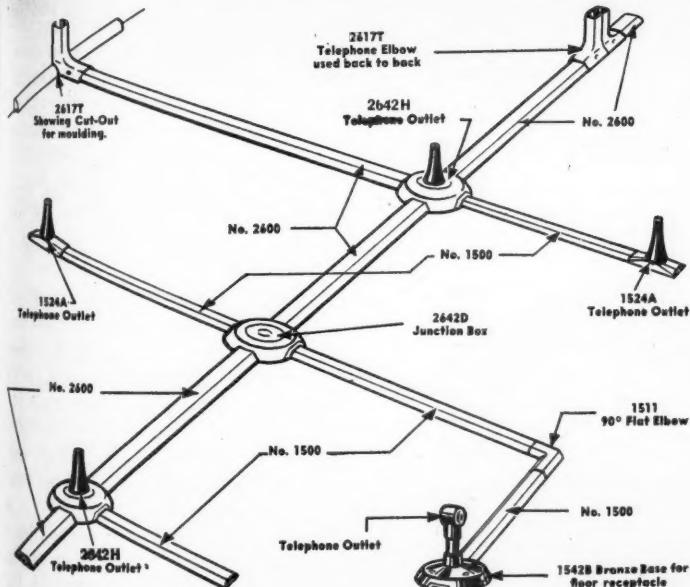
PANCAKE

WIREMOLD

OVERFLOOR WIRING SYSTEMS

• Wiremold PANCAKE is the safe, simple, practical way to handle all those situations where telephone or light and power circuits must be brought to locations out in the middle of a floor area . . . where the necessary wiring is being laid out for desk installations in general offices, or where changes in already installed wiring systems require relocation and extension of power service installations. No. 1500 PANCAKE is for general telephone or light and power service installations; No. 2600, with greater capacity, is especially designed for general office telephone system work. Write office for new PANCAKE bulletins full of helpful suggestions.

CAPACITY:
No. 1500 4 No. 12 R. C. Conductors
No. 2600 Two 26-pair telephone cables.



**WIREMOLD CAN HELP YOU
PRODUCE FOR WAR . . .
WHILE YOU PLAN FOR PEACE!**

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THE WIREMOLD COMPANY HARTFORD 10, CONN.



Check The Details— See why Wheeler means

"Skilled Lighting!"

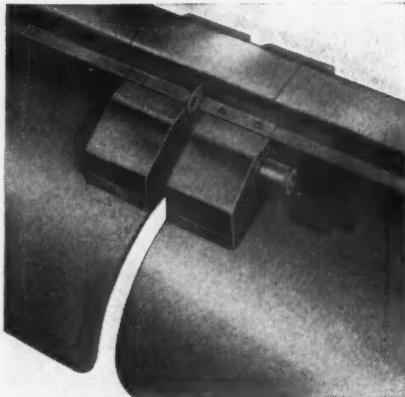


From end to end, Wheeler Reflectors are engineered with all the skill and experience of Wheeler's 62 years' specialization in lighting. They're "skilled lighting" that insures maximum lighting efficiency, durability, and convenience of installation and maintenance.

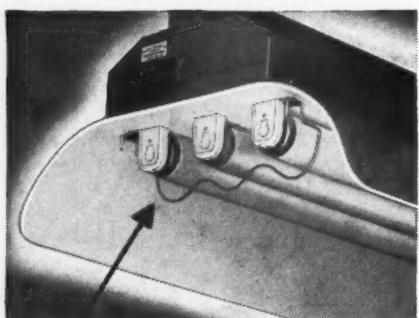
Examine a Wheeler Fluorescent Fixture, for example. Compare its high rigidity, obtained in spite of WPB metal-restriction, by Wheeler's I-beam wiring channel construction. Notice that wiring is completely metal-enclosed, yet instantly accessible. Also note the accessibility of starter switches; the speedy adaptability of the unit to continuous runs; and the ample provision of knock-outs for any type of mounting.

Whether you need fluorescent or incandescent fixtures, specify Wheeler and you'll get such "skilled lighting"! **Wheeler Reflector Co., 275 Congress St., Boston 10, Mass.... New York City. Representatives in principal cities.**

Distributed Exclusively Through Electrical Wholesalers



Simpler Wheeler coupling speedily adapts single units to continuous runs. Note I-beam wiring channel design and accessible starter switches.



Another Wheeler improvement! New Lamp Retaining Guard for modern fluorescent fixtures. Provides new safety... positively prevents falling lamps.

Fixtures should be carefully located so the lighting is not behind the operator's back. For the press department, general illumination of incandescent, fluorescent or mercury type should provide at least 20 foot-candles. If, however, there is no separate press department in the sheet metal shop, general illumination should not be less than 35 foot-candles. Operators, in general, like to see the stamping to judge the condition of the die. Corrections can then be made and breakage avoided on a die which may cost many times more than the most expensive lighting equipment that could be recommended.

Large Forming Presses—While there is less chance of doubling up stock (with consequent breakage of dies) on presses forming large pieces, there is a greater chance of foreign substances falling into them and causing trouble. Defects due to wearing, chipping and cracking must be closely and constantly watched.

Large presses may be lighted from the four corners with 50-watt rough service lamps in porcelain reflectors—if the units can be located close to the die. If the reflectors must be located at some distance from the die, 100-watt lamps or larger may be required in projector-type reflectors with slightly diffusing covers.

Other Types of Machines used in sheet metal fabrication include circle, slitting and curve shears; flangers; nibblers; forming and rolling machines; grooving machines; end seamers; and spinning lathes. Whether the shop is large or small, the important principles to remember are the same as those earlier discussed. A study should be made of each machine with specific attention being directed to the operator's use of his hands and eyes.

Lighting Costs—Good lighting has positive benefits and aids in production. Among the advantages it affords are—closer tolerances, fewer rejects, lowered spoilage, greater safety and increased morale. Invariably, the increased production is sufficient to pay for the lighting equipment in a relatively short time.

The cost of lighting has recently been analyzed in a number of defense plants. It was observed that the sum of the fixed and operating costs of machinery, including labor, amounts to about \$2.00 per 100 sq.ft. per hour. On the same basis for figuring charges, the best type of lighting costs only one cent per 100 sq.ft. per hour. On this basis, the differential between good lighting and poor lighting is only one half cent per 100 sq.ft. per hour. In effect, this small sum turns out to be cheap insurance against unnecessary waste of production labor or machinery.

Wheeler REFLECTOR COMPANY
Lighting Equipment Specialists Since 1881

fully located
and the oper-
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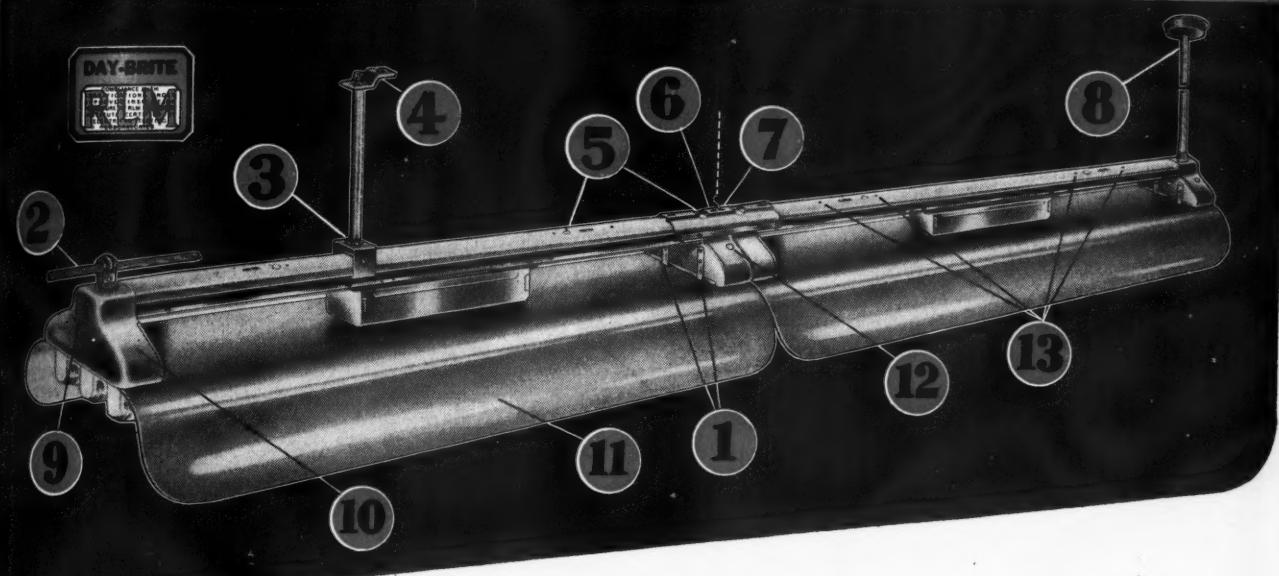
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1. 5-second on-and-off spring tension clips permit instant release and replacement of entire reflector.
2. $\frac{1}{2}$ " K. O. for cable clamp installation direct to fixture.
3. Slide channel clamps for rod or pipe hangers can be located at any point on channel.
4. Swivel type hanger strap is adjustable for pipe or rod alignment.
5. K. O.'s for pipe and cord.
6. Rigid one-piece coupling converts single units to continuous fixtures.
7. Chain hanger slots in top of channel and in center of coupling.
8. Complete pipe hangers with ceiling canopy and all fittings.
9. Large tear-out in end for through feed.
10. Rigid, one-piece, die-formed end boxes welded to channel assure rigidity and proper alignment of all parts.
11. Non-metallic reflectors (RLM and U. S. Bureau of Standards approved). Reflectivity factor, 85% or more. Angle of cutoff, 14°.
12. K. O. for switch.
13. Screw holes for direct surface mounting. No couplings needed.

The DAY-LINE... For Single Unit or Continuous Installations



13 POINTS Tell Why You Save INSTALLATION and MAINTENANCE DOLLARS

Latest of the many exclusive design features that make Day-Brite the low-maintenance fluorescent fixture is the 5-second on-and-off reflector. Slight finger pressure on 2 spring-tension clips at each end of the fixture releases the entire reflector. To replace, merely snap back into rigidly held position. Works fast—permits instant accessibility to the fixture body... Long life, continuously high illumination effectiveness is assured by Day-Brite's exclusive "Super-White" baked enamel finish—standard on all non-metallic reflectors. Another low-maintenance feature!

The Day-Line is supplied for single unit mounting or continuous runs—for 2-40 watt, 3-40 watt and 2-100 watt lamps... Consult your Day-Brite engineering representative—send for Bulletin F-69.

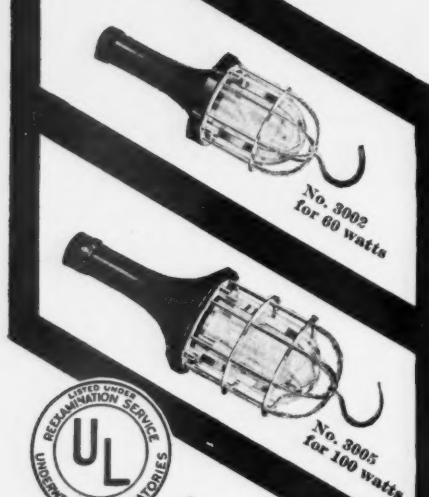
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COMMERCIAL · INDUSTRIAL and SPECIAL DESIGNS

Safeguard

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the Guard with the Seal-Tight Globes

Where there is a possibility of fire, or other disaster from a spark, exposed flame, heat or breaking of bulbs, then MCGILL Vaporproof Lamp Guards should be used on all portable or extension lights. The tight-sealing globe and heavy cage, with air-tight seal in handle opening, eliminate these hazards at every spot where this guard is used. These Vaporproof guards are designed to stand up under roughest use and abuse.

These guards also protect the light bulb and prevent breakage when used around machines where water and oil might splash on the bulb. Guards also are grounded—an additional safety feature.

ASK FOR LITERATURE

MCGILL MANUFACTURING CO., INC.
Electrical Division
Valparaiso, Indiana

MEGILL



WAREHOUSE ILLUMINATION of 15 foot-candles for safe and accurate handling of aircraft parts has been provided in this Vega Aircraft Corp. building. Fixtures of 500 watt have been installed on 15-foot centers and mounted 20 feet above the floor. Bennett-Forsberg Electric Co., Los Angeles contractor, made the installation. More than 500 Westinghouse units were used and are of the type with socket built into the hood for quick and safe relamping and cleaning.

ROLLING SCAFFOLDS SPEED INSULATION

Robinson Electric Co., lighting engineers and contractors of Charlotte, N. C., proved themselves equal to any task under the increased tempo of wartime installations. A Quartermasters Depot lighting job was contracted by Robinson just prior to the Pearl Harbor incident. Several days later, he was informed that only 35 days would be allowed to complete each of two buildings. The turn of events was as unexpected as the Jap attack, but Roy Robinson decided that he would equal or even beat this deadline somehow, or else.

The depot consisted of two buildings 180 feet by 1,200 feet. Each building was divided into six sections, 200 feet long, and the sections were all separated by thick firewalls. Six rows

of fixtures were run the entire length of the building spaced 25 feet apart. Building chords were spaced every 20 feet and fixtures likewise were spaced laterally on 20-foot centers. RLM dome reflectors for 500 watt incandescent lamps were used in the center and each 200 foot section was completely encircled by angle reflectors, also 500 watt incandescent (see accompanying plan layout).

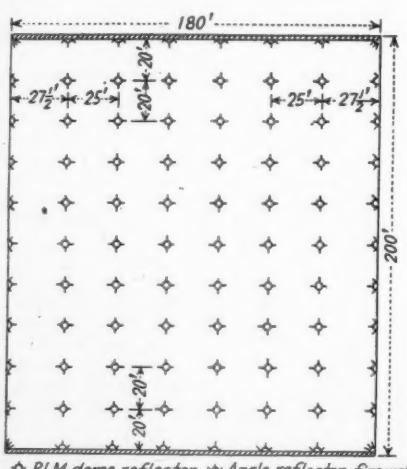
Robinson's first move was to break down the job into three operations. The first was punching holes (for outlet boxes and conduit straps) in the structural steel members of the building. The second was installing boxes, conduit and straps. The third was pulling wire, making splices, hanging fixtures and lamping.

To carry on the work, he built three rolling scaffolds of wood timber which were 3 feet wide, 12 feet long and 14 feet high. Six-inch casters were used for easy rolling across the new cement floors. The building chords were 20 feet off the floor and the 14-foot scaffolds put the men in easy reach of their work.

Starting at one end of the depot, the three scaffolds and their respective crews of ground and scaffold men worked each section right down the line. Doors were provided in the fire walls for truck passage and after completion of each section, scaffolds were squeezed through these openings into the next.

The first scaffold rolled through, laying-out and punching all holes in the steel. Then came the second, mounting boxes, conduit and straps. And here, the strategy of attack backfired. All material was on hand but the fixtures. However, the third crew

[Continued on page 173]



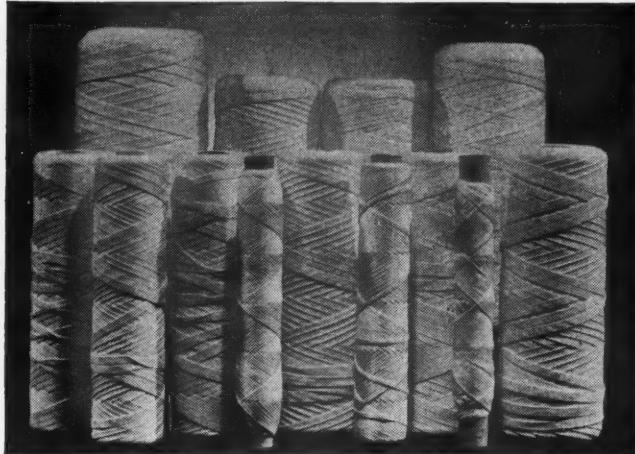
PLAN LAYOUT of one section of the Quartermasters Depot. RLM dome reflectors were used in the center area and angle reflectors completely encircled each section.

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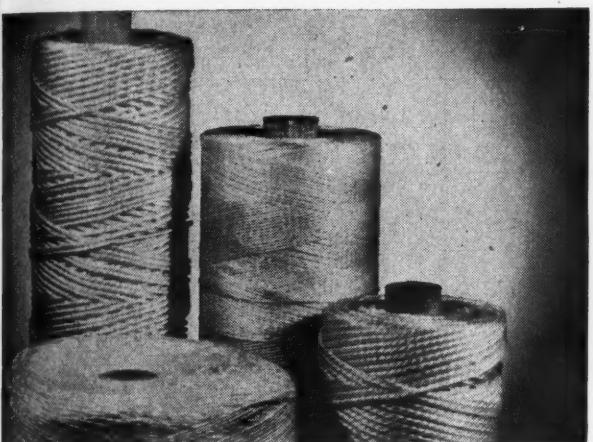
(Increased Fiberglas Production permits this Announcement to be Made)



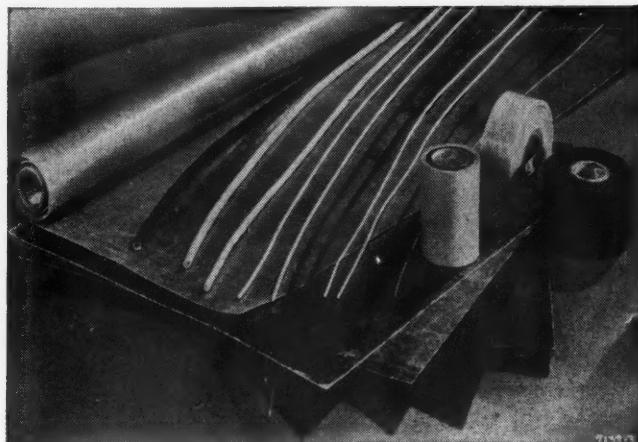
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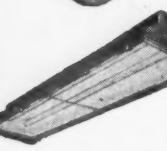
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Direct-Current Motors and Control—I

A general guide to facilitate the selection and application of motor drive to industrial operations.

DIRECT-CURRENT motor drive has inherent speed and torque characteristics that make it indispensable to a great number of industrial applications; and many methods of control have been developed to take full advantage of these characteristics. Variable voltage supply has long been one of the most flexible types of control; now the comparatively new electronic control has broadened the speed and torque range considerably over the older methods of obtaining variable voltage input to armature and field.

Every electric motor possesses certain inherent speed characteristics by which it can be classified into a specific category. The following classifications have been adopted by N.E.M.A. (National Electrical Manufacturers' Association.)

Constant-speed motor is one in which the speed is practically constant from no-load to full-load. Motors in this class may have an absolutely constant speed regardless of load, or the speed may vary a few percent from no-load to full-load.

Adjustable-speed motor is one in which the speed can be varied gradually over a considerable range, but when once adjusted, remains practically constant regardless of load.

Multi-speed motor is one which can be operated at any one of several definite speeds but, when once adjusted, remains practically constant regardless of load. It differs from the adjustable-speed motor in that the multi-speed motor can be operated only at certain definite speeds

without any gradual adjustment of the speed between these definite speeds.

Varying-speed motor is one in which the speed varies with the load, generally decreasing as the load increases.

Adjustable varying-speed motor is one in which the speed can be varied gradually over a considerable range but, when once adjusted, will vary in considerable degree with change in load, generally decreasing as the load increases.

The Shunt Motor

If we are to utilize these inherent characteristics of the direct-current machine, it will be necessary to review the forces which have effect on the shaft output.

If the shunt field of a d.c. machine is excited by connecting it to some d.c. source and the armature is rotated in the resulting magnetic field, a d.c. voltage (emf) is generated at the brushes and we have a shunt generator.

If we take this same d.c. machine and connect the brush terminals to the same d.c. source of power that supplies the shunt field, we have a shunt motor. However, we now have two voltages (emfs). One is the applied emf from the d.c. supply lines and the other is the same generated emf that was present in the generator. This generated emf results from the armature conductors revolving in the field flux (ϕ) of the shunt field coils. The faster the conductors cut the flux, the greater will be the generated emf and vice versa.

The armature current flows in the armature conductors in a direction dictated by the applied emf. Since the generated emf is opposed to the direction of this armature current flow it is called counter emf. Thus the applied emf must be large enough to overcome the counter emf and also to send the armature current through the armature resistance.

From this it will be seen that a starting resistance is needed to start even smaller sized d.c. motors, for the counter emf which limits armature current to safe values when running is not present until the motor begins rotation. It then increases to a maximum at maximum speed (assuming that shunt field excitation remains constant). For instance, consider a motor designed for a normal full-load current of 100 amperes, and having an armature winding resistance of 0.25 ohms. If this motor is connected directly across 250 volts, a starting current of 1000 amps. would flow through the armature conductors. This would not only be dangerous to the winding, but the resulting high starting torque effort might produce an injurious shock to the driven machine. If a starting rheostat having a resistance of 2.25 ohms is connected into the armature circuit, the total resistance would be 2.50 ohms and the starting current would be limited to 100 amps. This would give a starting torque of only 100 percent, and therefore in actual practice a rheostat with less resistance would be used to get enough more starting current to produce 150 to 200 percent starting torque. As the motor picks up speed the starting resistance

is gradually cut out to maintain balance with the increasing counter emf. Finally at full-speed and full-load (100 amps.) the starting resistance will be entirely cut out and the counter emf will equal 225 volts. This is derived from the formula:

$$E_g = E_a - I_a R_a \text{ volts}$$

where E_g is the counter emf; E_a is the motor terminal emf; I_a is the armature current; and R_a is the armature circuit resistance. (In the case of a compound motor R_a would also include the series field resistance.)

E_a has been given as 250 volts; I_a for full-load is 100 amps. and R_a equals 0.25 ohms.

Thus the counter emf at full-load and speed is:

$$\begin{aligned} E_g &= E_a - I_a R_a \\ &= 250 - 100 \times 0.25 \\ &= 250 - 25 \\ &= 225 \text{ volts under normal full-load operating conditions.} \end{aligned}$$

Torque and Speed

The torque of a motor is proportional to the number of conductors on the armature, to the current per conductor, and to the total flux (ϕ) of the machine. Likewise the speed of the machine depends upon the number of conductors, the flux, the number of paths, the number of poles and the counter emf.

Since for any given machine most of these factors are fixed and constant (that is, the number of conductors, the number of paths, and the number of poles), torque and speed equations can be derived as follows:

$$\begin{aligned} \text{torque} &= \text{a constant} \times I_a \times \phi \\ \text{speed (rpm)} &= \text{a constant} \times \frac{E_a - I_a R_a}{\phi} \end{aligned}$$

where I_a is the armature current and ϕ is the machine flux. $E_a - I_a R_a$ is recognized as being equal to E_g , the counter emf. Thus the torque is directly proportional to the armature current and the machine flux. In other words, an increase in armature current results in an increase of torque. Or an increase in field flux gives an increase in torque. Vice versa, a decrease in either, or both, results in a decreased torque. Fig. 2 shows that for a shunt motor where the field flux ϕ is held constant, the torque varies directly with the armature current.

The speed on the other hand is directly proportional to the counter emf and inversely proportional to the field flux. That is, an increased counter emf increases the speed while a decreased counter emf decreases the speed. Since the flux is inversely proportional to the speed, an increase of flux decreases the speed; a decrease of flux increases the motor speed.

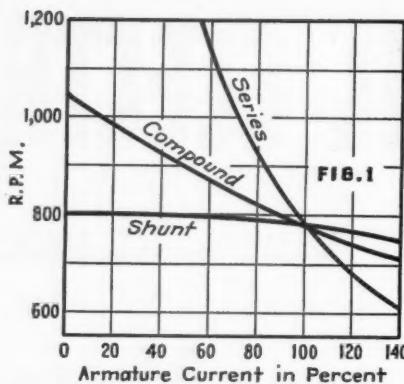


FIG. 1—Speed curves for the three types of d.c. motors follow the pattern shown above. Note that the speed of the shunt motor is fairly constant over the entire range of armature current from no-load to full-load. Note also that as the series motor approaches no-load, its speed increases at a great rate.

For instance, examine the speed equation more closely to see just how the shunt motor reacts under conditions of obtaining adjustable speed. By inserting resistance in series with the armature winding, the effect is to reduce the counter emf by reducing the applied voltage across the armature. The line voltage remains constant. The rheostat resistance in series with the armature consumes a certain part of the total line voltage while the balance is applied across the armature. Thus the speed is reduced and the counter emf is likewise reduced.

As an example, suppose the line voltage is 250 volts. The shaft is delivering full-load torque at an armature current of 100 amps. Winding resistance is 0.25 ohms. With no resistance in the armature circuit, the applied voltage equals the line voltage and the counter emf is equal to:

$$\begin{aligned} E_g &= E_a - I_a R_a \\ &= 250 - 100 \times 0.25 \\ &= 250 - 25 = 225 \text{ volts} \end{aligned}$$

Refer now to the torque equation. It is seen that the torque delivered to

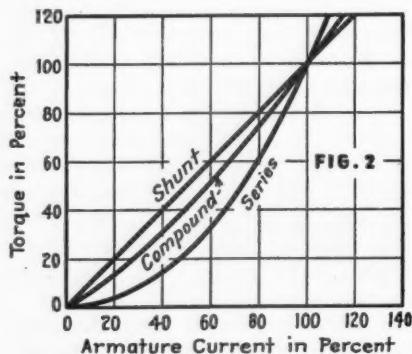


FIG. 2—The torque curve for the shunt motor is a straight line which means that a constant ratio exists between armature current and torque over the entire load range. The strength of the series field determines the amount of curvature in the compound and series motor curves.

the load is proportional to the armature current I_a . Therefore, in order that the load torque remain constant, the armature current must also remain constant (assuming no change in field flux).

Now suppose we insert a resistance of 0.75 ohms into the armature circuit. The immediate effect is to reduce armature current, which reduces the developed torque, which in turn slows down the armature. The reduction in armature speed reduces the rate at which the armature conductors cut the field flux and results in a reduction of the counter emf.

The reduced counter emf allows the current in the armature winding to build back up to the original value required to deliver full-load torque to the load. The new conditions of operation are:

1. Torque delivered to load is the same.
2. Armature current is the same (100 amps.)
3. Voltage applied directly across armature (E_a) is reduced.
4. Counter emf (E_g) is reduced.
5. Speed is reduced.

For a computation of these results:

1. Torque delivered to the load remains the same—100 percent.
2. Armature full-load current must necessarily remain the same—100 amps. to maintain 100 percent torque.

3. Since the armature current is 100 amps., the voltage drop across the rheostat resistance of 0.75 ohms equals 100×0.75 or 75 volts. The motor terminal voltage (E_a) is therefore reduced from line voltage (250 volts) to 250 - 75 volts or 175 volts.

4. The counter emf is also decreased. Since the armature current (100 amps.) and armature resistance (0.25 ohms) is still the same, E_g is now equal to $E_a - I_a R_a$ or $175 - 25$ volts or 150 volts.

5. Since the speed equation shows the speed to be directly proportional to the counter emf, the new speed is:

$$\begin{aligned} \text{RPM} &= 100\% \times \frac{150}{225} \\ &= 66\frac{2}{3}\% \text{ of normal speed.} \end{aligned}$$

Thus, it is seen that motor speed can be reduced below basic, (that is, the speed that exists with full-field and no resistance in the armature circuit) by the introduction of an external resistance in series with the armature. A variable voltage supply to the armature circuit will give the same result and is the basis for the comparatively new electronic control d.c. drive and for the traditional Ward Leonard system operation.

SUMMARY OF MOTOR CHARACTERISTICS

| Type of motor | Standard hp. ratings | Speed characteristics | Speed control | Locked-rotor starting current with rated impressed voltage in percentage of full-load current | Starting torque in percentage of full-load rated torque | Max. running torque in percentage of full-load rated torque | General application suited for |
|--|----------------------|---|--|---|--|---|--|
| 1. Direct current, shunt, constant speed | Up to 200 | Constant; not more than 10 percent change in speed from no load to full load | Speed may be increased 25 percent above normal by field control; speed may be reduced any amount below normal by armature control but speed then varies widely with load | Very high; normally reduced to 150 percent of rated full-load current by series starting resistance | Maximum with full voltage, 250 to 300; when started in normal manner, average, 150 | Would occur at standstill but limited by commutation to 200 | Constant or slightly adjustable-speed service with light or medium starting duty |
| 1. Direct current, shunt, adjustable speed | Up to 200 | Nearly constant for any field adjustment not more than 15 percent change in speed from no load to full load | Speed range of 4:1 for all loads by field control. Speed may be reduced by armature control but speed then varies widely with load | Same as 1 | Same as 1 | Same as 1 | Adjustable-speed service with close speed regulation and either light or medium starting duty. Motors available for either constant-torque or constant-horsepower service |
| 1. Direct current, compound, 20 percent series, 80 percent shunt | Up to 200 | Slightly varying speed, changes approximately 25 percent from no load to full load | Same as 1 | Same as 1 | Maximum with full voltage, 300 to 350, when started in normal manner, average 170 | Would occur at standstill but limited by commutation to 300 | Heavy starting duty or intermittent peak-load service or combination of the two duties |
| 4. Direct current, compound, 50 percent series, 50 percent shunt | 3 to 200 | Varying | Same as 1 | Same as 1 | Maximum with full voltage, 400; when started in normal manner, average 200 | Would occur at standstill but limited by commutation to 350 | Heavy intermittent starting duty or heavy running loads for short periods with alternate light loads; adjustable varying-speed service |
| 5. Direct current series | 3 to 200 | Varying | Same as 1 | Same as 1 | Maximum with full voltage, 450; when started in normal manner, 225 to 300 | Would occur at standstill but limited by commutation to 400 | Heavy intermittent starting duty or heavy running loads for short periods of time, adjustable, varying-speed service. Motor should at all times be loaded or under control of operator |

Speeds above basic can be obtained by weakening the shunt field current which decreases the strength of the field flux (ϕ). This is readily apparent from the speed equation.

$$RPM = \text{a constant} \times \frac{E_a - I_a R_a}{\phi}$$

Assume the "constant" equals 10,660,000; the counter emf equals 225 volts; and the flux ϕ equals 2,400,000 lines per pole. Therefore:

$$RPM = 10,660,000 \times \frac{225}{2,400,000}$$

= 1,000 revolutions per minute

Now suppose we weaken the field by inserting enough resistance in the

shunt field circuit to reduce the effective flux ϕ per pole to 1,200,000 lines, then:

$$RPM = 10,660,000 \times \frac{225}{1,200,000} \\ = 2,000 RPM$$

By using a continuous-slide field rheostat, any speed between 1,000 and 2,000 rpm can be obtained in this particular example. A common combination of field and armature control is to employ armature control for reducing the speed to 50 percent below normal and field control to increase the speed to 25 percent above normal.

Speed control of shunt motors by armature resistance is not very satis-

factory since the speed regulation is bad. For instance, if a motor is operating at full-load current and at half speed, then about 50 percent of the line voltage is consumed in the speed control rheostat. If now the load is reduced to half-load drawing about half the full-load current, only 25 percent of the line voltage is now consumed in the rheostat. The counter emf increases and the motor speed increases proportionately from 50 percent to 75 percent of normal speed (unless the rheostat resistance is automatically increased as the load decreases). Due to the large voltage drops across the external resistance,

APPROXIMATE EFFICIENCIES OF D. C. MOTORS

| HP. | Percent Efficiency | | | HP. | Percent Efficiency | | |
|-----|--------------------|--------|-----------|-----|--------------------|--------|-----------|
| | ½ Load | ¾ Load | Full Load | | ½ Load | ¾ Load | Full Load |
| ½ | 65.0 | 70.0 | 72.0 | 25 | 83.0 | 86.0 | 87.0 |
| 1 | 70.0 | 73.0 | 75.0 | 30 | 84.0 | 87.0 | 88.0 |
| 1½ | 72.0 | 76.0 | 78.0 | 40 | 85.0 | 87.5 | 88.5 |
| 2 | 72.0 | 77.5 | 81.0 | 50 | 85.5 | 88.0 | 89.5 |
| 3 | 72.0 | 77.0 | 79.0 | 60 | 85.5 | 88.0 | 90.0 |
| 5 | 77.0 | 81.0 | 81.5 | 75 | 88.0 | 89.0 | 90.5 |
| 7½ | 79.0 | 82.0 | 83.5 | 100 | 86.0 | 89.0 | 90.5 |
| 10 | 81.0 | 83.0 | 85.0 | 125 | 88.0 | 89.0 | 90.5 |
| 15 | 81.5 | 84.5 | 86.0 | 150 | 87.0 | 90.0 | 91.0 |
| 20 | 82.0 | 85.0 | 86.5 | 200 | 89.0 | 91.5 | 92.0 |

REPRESENTATIVE APPLICATIONS OF D. C. MOTORS

| Shunt | Compound | Series |
|--|---|--|
| Agitators Blowers Conveyors Fans Line shafts Printing presses Pumps Mixers Most woodworking machines Most machine tools | Balers Bending rolls Bulldozers Metal drawers Punch presses Shears | Baling presses Bridges Cranes Car retarders and pulleys Coke-oven machinery Hoists Hydraulic Cages Lorry cars Rotary car dumpers Yard locomotives |

operation in the armature control range gives a system efficiency that is quite low.

The Series and Compound Motors

The field of the series motor is connected in series with the armature winding. Thus, any increase in armature current due to increased load gives a proportional increase in field flux ϕ . Therefore, referring to the torque equation it is seen that the torque increases as the square of the armature current and is shown in Fig. 2.

The increased flux at increased load is reflected also in the motor speed. The rpm drops considerably (as shown in Fig. 1) as the load, armature current and consequently the field flux increases.

GUIDE TO SELECTION OF TYPE OF MOTOR

| Load Requirements | | Direct Current |
|--|--|---|
| Running | Starting | |
| All classes of loads requiring constant speed with no speed control | Very light starting duty | Shunt, constant-speed type |
| | Light starting duty (starting torque not greater than 100 percent of full-load torque) | Shunt, constant-speed type |
| | Medium starting duty (starting torque from 100 to 150 percent of full-load torque) | Shunt, constant-speed type |
| | Heavy starting duty if at not too frequent intervals and if starting period is of not too long duration (starting torque from 150 to 200 percent of full-load torque) | Shunt, constant-speed type |
| | Very heavy starting duty requiring starting torques above 200 percent of full-load torque or very frequent starting or starting periods of long duration | Compound, with series field cut-out after starting |
| All classes of loads requiring adjustable speed with not much change in speed from no load to full load for any speed setting | Light starting duty (starting torque not greater than 100 percent of full-load torque) | Shunt, adjustable speed type for either constant-horsepower or constant-torque service |
| | Medium starting duty (starting torque from 100 to 150 percent of full-load torque) | Shunt, adjustable-speed type for either constant-horsepower or constant-torque service |
| | Heavy starting duty, if at not too frequent intervals and if starting periods are of not too long duration (starting torque from 150 to 200 percent of full-load torque) | Shunt, adjustable-speed type for either constant-horsepower or constant-torque service |
| | Very heavy starting duty requiring starting torque above 200 percent of full-load torque, very frequent starting or starting periods of long duration | Compound wound with series field cut out after starting |
| Intermittent peak loads where it is desirable for motor to have slightly varying-speed characteristics in order to prevent excess motor overloads (flywheel machines); peak loads should occur less than 25 times per minute; any service where a slightly varying-speed characteristic is not objectionable or is desirable | Light or heavy starting duty if at not too frequent intervals and if starting periods are of not too long duration | Compound, 20 percent series, 80 percent shunt |
| Varying or adjustable varying-speed service; any service where it is desirable or not objectionable to have speed decrease with increasing load; service requiring heavy torque for short periods with some speed control during light loads | Very heavy starting duty or starting at very frequent intervals or starting periods of long duration | Compound, 20 percent series 80 percent shunt |
| | Any type of starting duty | <ol style="list-style-type: none"> 1. Compound, 50 percent series, 50 percent shunt 2. Series if motor is always under control of operator or if there is no danger of motor losing its load or if motor is protected by an over-speed device |

At light loads, when the armature current decreases toward zero, the field flux likewise decreases and the effect is the same as opening the field of a shunt motor, that is, the armature rpm increases to higher and higher speeds usually resulting in complete motor destruction. For this reason series motors should always be geared or direct-connected and never belted, for if the belt is broken, the armature would run away. For the same reason the field of a shunt motor should never be opened. This series motor speed characteristic is shown graphically in Fig. 1.

For a given load, and therefore for a given current, the speed of a series motor can be increased by shunting the series winding or by short-circuiting some of the series turns so as to

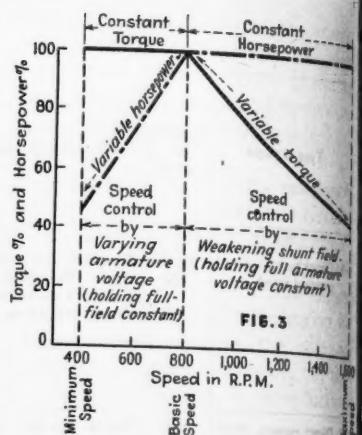


FIG. 3.—Constant torque will be delivered by this motor throughout the armature control speed range from 400 to 800 rpm and the horsepower output can be increased from 50 percent to 100 percent over the same range of speed without exceeding safe temperature limits. Full-field strength is maintained from 400 to 800 rpm. At 800 rpm the armature voltage is at a maximum; further speed increase is obtained by weakening the field. Applied armature voltage is held constant, horsepower output remains constant and the torque tapers off from 100 percent as the motor speed approaches maximum.

reduce the flux. The speed can be decreased by inserting resistance in series with the armature.

The compound motor is a compromise between the shunt and series motor. The series winding assists the shunt winding so that the flux per pole increases with load. Thus the torque increases more rapidly and the speed decreases more rapidly than if the series winding were not connected. The motor cannot run away on light loads because of the shunt field excitation. The speed and torque characteristics are as shown in Figs. 1 and 2. The speed of a compound motor can be adjusted in exactly the same manner (by armature and field rheostats) as in the shunt motor previously described.

Maximum values of starting torques are limited only by the motor's ability to commutate satisfactorily. This condition limits shunt motor starting current to about 200 percent which produces a starting torque of about 200 percent. Likewise, compound and series motor currents are limited to about 250 percent producing starting torques of 300 percent and 400 percent for the compound and series motors respectively.

The standard starting rheostat on the first point limits armature current to about 150 percent of the full-load current. This current will produce a starting torque of about 150 percent of full-load torque for the shunt motors; about 175 percent for the compound motor; and about 225 percent

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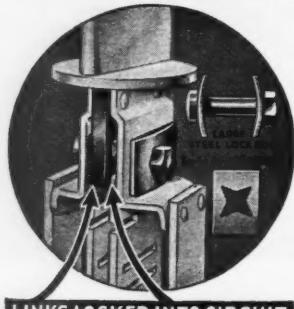
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for the series motor. Greater starting current and torque can be obtained by advancing the starter to the second or third point.

Motor Ratings

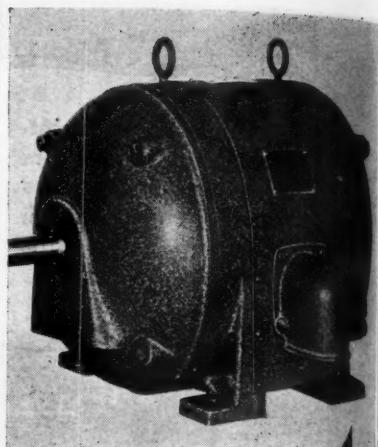
Since the most important factor in motor rating is temperature, or rather, heat dissipating ability, it is readily seen that an open motor can get a higher horsepower rating than an enclosed motor, since the open motor is better ventilated and has more exposed radiating surface. Likewise, the shorter the time rating of the machine, the higher the horsepower rating since there is less time to accumulate heat and more time between operating cycles to dissipate that accumulated heat.

For instance, a given frame will have a rating of 12 hp. at 500 rpm as an enclosed machine for continuous duty; or 19 hp. at 500 rpm as an open machine for continuous duty; or 31 hp. at 500 rpm with a 1-hr. rating; or 40 hp. at 500 rpm with a half-hour rating. The temperature rise on full load is 40°C as an open machine; 50°C as an enclosed machine. Horsepower is proportional to speed over a range of 30 percent above or below the rated speed.

For this reason a motor should be specified only for its intended duty cycle and no more. When a motor is purchased, the cost is chiefly based on frame size. Consequently, the more horsepower that can be crammed into a given frame, the more can be obtained for the dollar.

If two machines are built on like frames for the same output and speed but for different voltages, the number of commutator segments will be proportional to the voltage and the commutator length will be proportional to the current. The low voltage machine will be the heavier because of the long commutator, but for moderate outputs, there will not be much difference in cost between a 120 volt and a 600 volt machine. The cost of the extra copper on the low voltage commutator is compensated for by the cost of the extra labor on the high-voltage commutator.

The output of a machine equals the product of (volts per conductor) \times (current per conductor) \times (the number of conductors). For a given frame, the volts per conductor are directly proportional to the speed. The product of the (current per conductor) and the (number of conductors) is constant for a constant current density and a constant weight of copper. Therefore, the output is directly proportional to the speed. Consequently, the higher the speed, the larger the output, and therefore the longer the commutator, the heavier the machine and the higher the cost.



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DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

T-4

Transformer Connections

7 STANDARD—THREE-PHASE—CLOSED DELTA

When three transformers are operated in a closed delta bank care should be taken to make certain that the impedances of the three units are practically the same. Transformers having more than 10 percent difference in impedance rating should not be operated together in a closed delta bank unless a reactor is used to increase the impedance of the unit having the lower impedance rating to a value equal to the other units.

It is always best before connecting up three transformers in closed delta to insert a fuse wire between the ends of the two transformers closing the delta bank. The fuse wire should be of sufficient size to carry the exciting current of the transformers. The use of this fuse wire offers a very simple means of making certain that the transformers have the proper polarity.

If the voltage ratio of all three of the transformers is not the same, there will be a voltage tending to circulate a current inside the delta. The current will be limited by the impedance of the three transformers considered as a series circuit.

8 THREE-PHASE: STAR, THREE-WIRE; DELTA, THREE-WIRE

When three transformers are operated with their high-voltage windings in star, the incoming line voltage is the $\sqrt{3}$ or 1.732 \times the transformer winding voltage.

This connection is very popular and presents a very convenient way of boosting the transmission voltage without purchasing additional transformers.

In general, all distribution transformers of the 7820-volt class and less are insulated for star connection on the high-voltage windings. In this connection it is not necessary that the impedance of the three transformers be the same.

At least the bad effects of the unbalanced impedances will not be so marked as with the delta-delta connection.

9 THREE-PHASE: STAR, FOUR-WIRE: DELTA, THREE-WIRE

This connection permits 3-phase power to be transmitted at the star voltage. At the same time single-phase power may be taken from the mains by connecting a single-phase transformer between the neutral and any of the three phase wires.

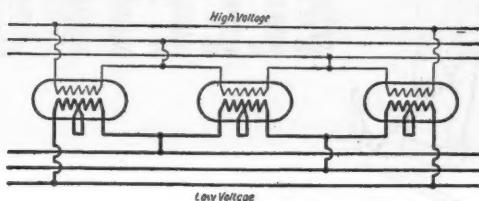
In this connection it is not necessary that the impedance of the three transformers be the same.

10 THREE-PHASE: STAR, FOUR-WIRE, ONE LEG OUT: OPEN DELTA, THREE-WIRE

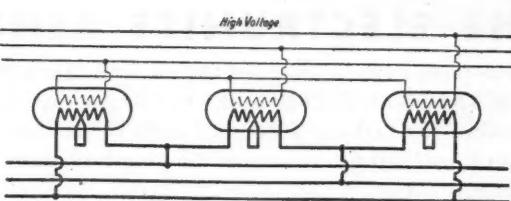
This is similar to a V connection. The primary of the two transformers is connected between the neutral and each of two of the three-phase wires. The secondaries are connected to the secondary mains, the same as for the delta connection, except that the third transformer is not used. (The secondaries are in open delta). 86.6 percent of the rated capacity of the two transformers can be obtained.

11 THREE-PHASE: DELTA OR STAR: STAR, INTERCONNECTED

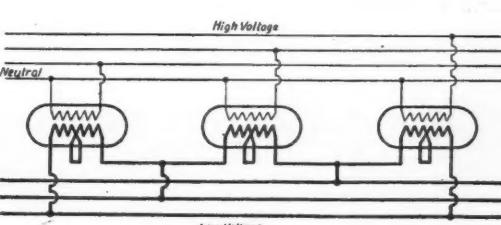
The primary side of this group may be connected either in star or in delta. Each half of the secondary winding of each transformer has a voltage of $\frac{3}{4}$ of the interconnected star voltage. A bank of transformers designed for connection in this manner will have a capacity 7½ percent greater than the kva. transformed. The purpose of the interconnected star winding is to permit the unbalanced d.c. current from the third wire of the three-wire circuit of a rotary converter to get back into the alternating current system feeding the converter. Since this d.c. current divides into two equal parts in each transformer and also these parts flow in opposite directions magnetically in the two parts, the d.c. current does not magnetize the core. If this current would flow in one direction through the winding the d.c. magnetic flux would add to the a.c. flux and perhaps saturate the core.



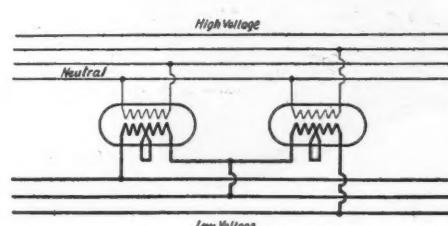
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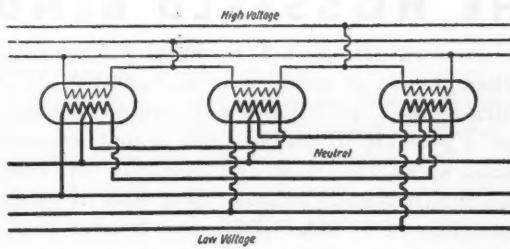
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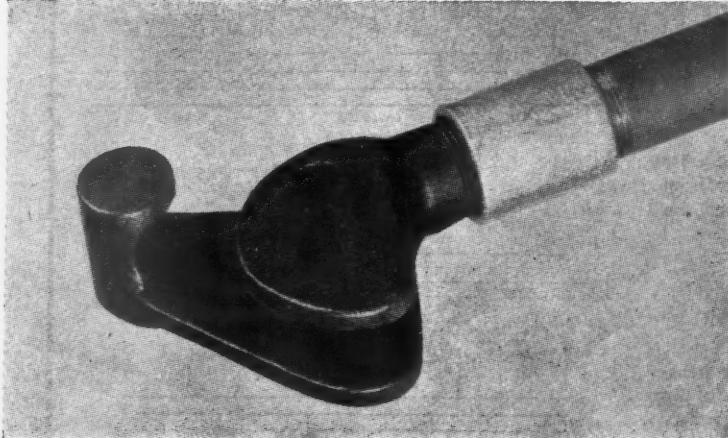
Information obtained from Westinghouse Electric & Mfg. Co.



These Accessories Will Simplify Your Work With ELECTRUNITE Steeltubes

THE ELECTRUNITE BENDER

A one-piece casting designed for use with "Inch-Marked" ELECTRUNITE STEELTUBES to provide the ideal combination for making accurate bends of uniform radius. With it you can predetermine the length of stubs and the distance between back-to-back bends. You can make offset and saddle bends to exact measurements. Basic measurements and instructions are cast into the bender—cannot become lost. Made in three sizes—for $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1" tubing.

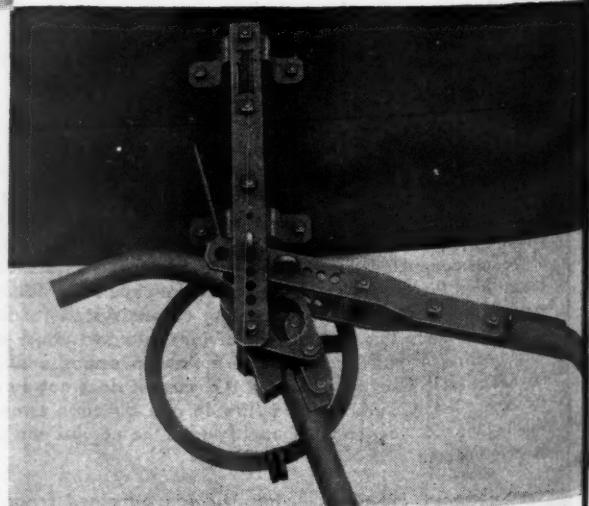


THE HICKEY BENDER

When it is necessary to make bends sharper than Standard Code radius, the STEELTUBES Hickey Bender should be used. This handy tool will produce bends of any desired radius. To insure against kinking, the tube should be "inched" through, not more than 10° being bent at one time. Used with the Mandrel Spring, the Hickey is ideal for stubbing up in concrete. It is made in six sizes—for $\frac{1}{2}$ ", $\frac{3}{4}$ ", 1", $1\frac{1}{4}$ ", $1\frac{1}{2}$ " and 2" tubing.

THE HOSSFELD BENDER

The standard size No. 2 Hossfeld Bender will make excellent bends in all sizes of ELECTRUNITE STEELTUBES from $\frac{1}{2}$ " to 2". New and improved bending dies make it possible to produce full, round, smooth bends in sizes up to $1\frac{1}{2}$ " with one sweep of the hand lever. When it is necessary to make quantities of bends in the larger sizes of STEELTUBES, this bender will quickly pay for itself.



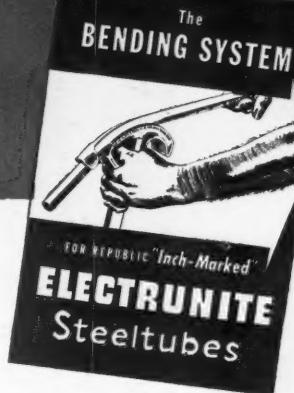
ies will help you use

es TO BEST ADVANTAGE

To enjoy the maximum ease and accuracy with which ELECTRUNITE STEELTUBES can be worked, you should use the accessories illustrated on these pages.

See your ELECTRUNITE Distributor. He has these accessories in stock and will demonstrate them for you. He also carries a full line of high quality electrical supplies for your convenience.

In the meantime, write for a copy of the booklet, "The Bending System for Republic 'Inch-Marked' ELECTRUNITE STEELTUBES." It's a 68-page book full of helpful suggestions.



REPUBLIC STEEL CORPORATION

Steel and Tubes Division, Dept. C

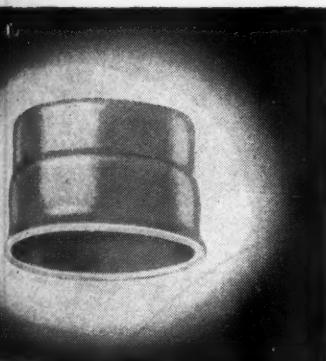
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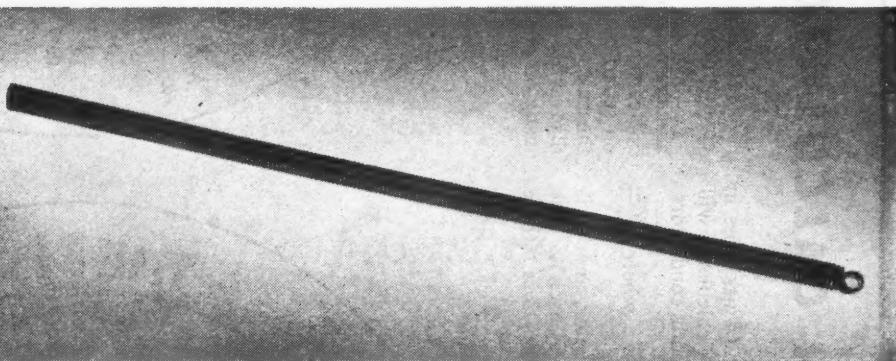
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THE END CAP

When using ELECTRUNITE STEELTUBES in concrete slab construction, you will find this end cap a handy accessory. It fits snugly over ends of stubs and prevents concrete or other foreign matter from entering. Made in $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1" sizes.



THE MANDREL SPRING

Short radius bends can be produced in one sweep with the Hickey Bender when it is used in conjunction with the Mandrel Spring in $\frac{1}{2}$ " and $\frac{3}{4}$ " sizes. This spring fits inside the tube and acts as a mandrel to prevent kinking. After making the bend, the spring may be removed by backing up slightly on the bend or by twisting the spring. Emergency bends can be made by using the mandrel spring only. This practice should be employed, however, only when conditions make it impossible to use other methods.



Republic "INCH-MARKED"
ELECTRUNITE
Steeltubes

ELECTRICAL METALLIC TUBING MARKED WITH A CONTINUOUS FOOT-RULE

DATA SHEET

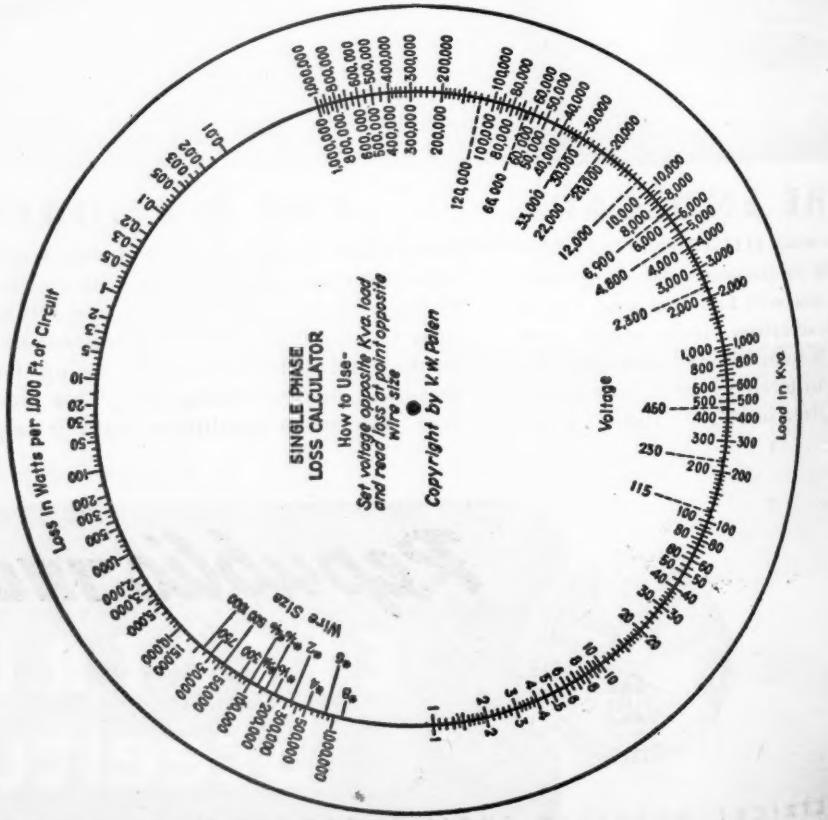
F-5

I²R CALCULATORS

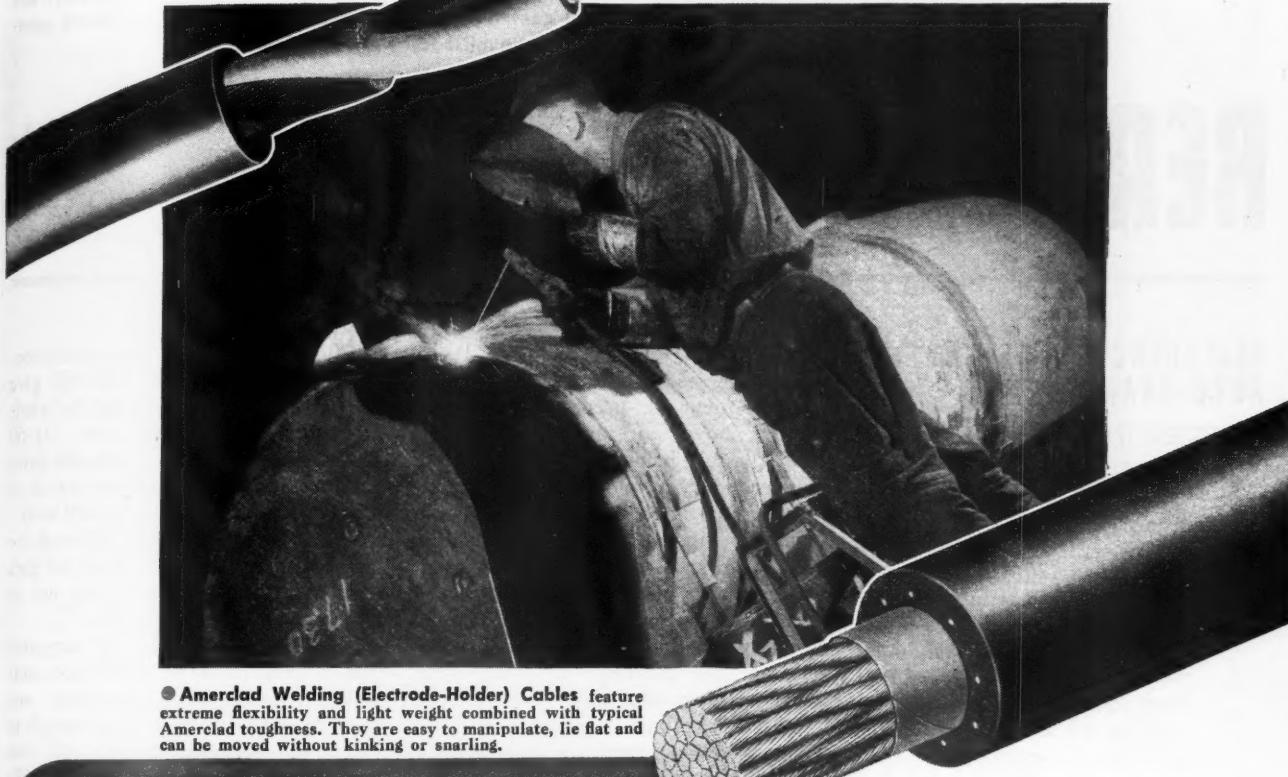
The two calculators reproduced below determine I²R (watts) loss in single-phase and three-phase circuits. The single-phase calculator will give the watts-loss for the complete circuit, that is, both conductors, and is based on the equation $\left[\frac{\text{kva.}}{\text{kv.}}\right] \times 2R = W$; where $\frac{\text{kva.}}{\text{kv.}}$ is current, R is resistance per 1000 feet of single conductor, and W is watts per 1000 feet of circuit (two conductors, 1000 feet each). The three-phase calculator also gives complete circuit watts loss (three made on one side and three-phase on the other).

conductors), and is based on the equation $\left[\frac{\text{kva.}}{\sqrt{3} \text{ kv.}}\right]^2 \times 3R = W$, and the notation is the same as for the single-phase case.

Reproduce carefully and cutout each disc and ring. Mount each disc on separate pieces of cardboard. On a third piece of cardboard mount the rings on reverse sides. Then punch center holes and assemble the discs with their respective ring. Thus single-phase calculations can be made on one side and three-phase on the other.



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● Amerclad Welding (Electrode-Holder) Cables feature extreme flexibility and light weight combined with typical Amerclad toughness. They are easy to manipulate, lie flat and can be moved without kinking or snarling.

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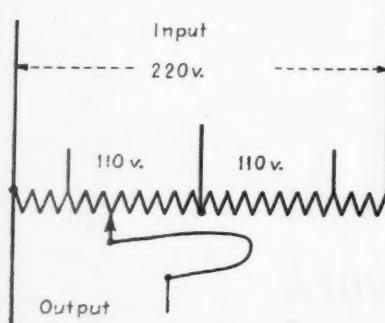
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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

READER'S QUIZ

DESIGNING AN AIR-COOLED AUTO-TRANSFORMER

QUESTION 129. I am contemplating building an auto-transformer with variable taps to be used for intermittent testing purposes. I want it suitable for the nominal 110/220 volt range on 60 cycle and with maximum output in kva. within 25 percent above or below normal input voltage. I have the core and want some good practical suggestions on the design of the winding.



The core is a rectangular stacking of L shaped punchings and has a cross section of approximately 10.5 square inches with a magnetic path having a mean length of about 26 inches.

I plan to hand wind from a bobbin around the core with a single layer so that the large number of taps will not be a problem.

Efficiency and continuous rating is not a factor due to the loadings being for a short period. Would a few turns energized at low voltage give any data if current and voltage were measured? This should give an indication of the turn voltage and magnetizing current required, but how about percent impedance and wire size? The winding connections will be as shown on the above elementary diagram.—E.J.K.

A. TO QUESTION 129. It is suggested that a two volt per turn gradient be used. The wiring sketch shows an arrangement for 110/220 volt primary with 0 to 280 volt secondary in two volt steps. Mount the terminal board on top of core and bring up taps as shown. Then if a voltage from 0 to 18 volts is desired use the lower row, with one lead on 0 and the other on the desired voltage. For any other voltage up to 280 volts subtract the marking in lower row from those in two upper rows to get the desired voltage. For instance if 248 volts is desired connect to terminals 260 and 12. $260 - 12 = 248$.

Wound with No. 6 copper enamel cotton insulation wire will give a short time rating of 70 amperes or 15.4 kva. at 220 volts. No. 10 wire would give a rating of 40 amperes or 8.8 kva. at 220 volts. If other sizes of wire are used the short-time rating of the auto-transformer will be in the same proportion.

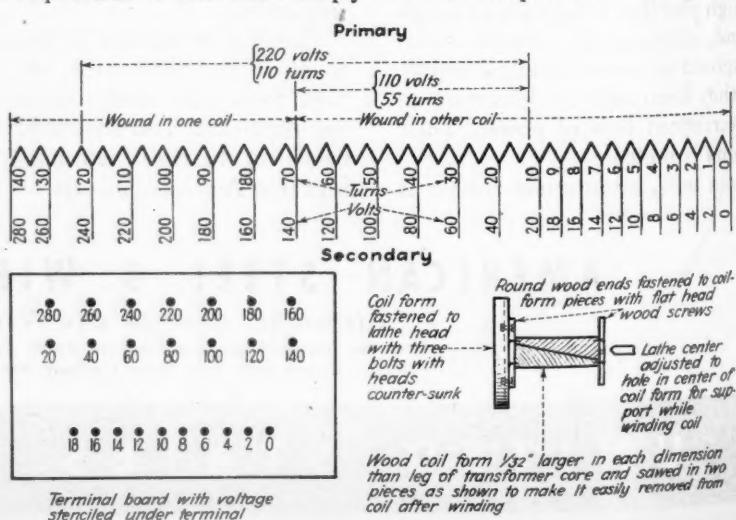
The exciting current will depend on grade of iron used in the core, closeness of joints in core and lines of flux per unit area of iron. The ampere turns required to excite the core could be found by testing before the coils are wound by winding 20 turns of No. 10 wire on the core and applying two volts per turn or 40 volts. Measure the amperes required at 40 volts and multiply

by 20 to get ampere turn excitation. This value divided by 110 will give exciting current required for the winding as designed at 220 volts. At 60 kilolines of flux per sq. inch the excitation would be 800 ampere turns or $800/110 = 7.27$ amperes at 220 volts.

The impedance will be different for each ratio used but it will not be high enough to interfere with the use of transformer for test purposes.

If a lathe is available it is suggested that a coil form be made and coils wound; taps made, insulated and brought out with leads long enough to reach the terminal board; and iron laminations be stacked in the coils rather than winding with a bobbin. Three layers of 0.010 inch fish paper should be wound on the coil form before winding the wire. This will insulate the wire from iron and keep from grounding or shorting the coils. With this method a better job can be done and two or more layers of wire used if necessary to get the right number of turns per coil.—A.W.S.

A. TO QUESTION 129. If E.J.K. has an L shaped core with a cross section of 10.5 square inches, the turns figured at 50,000 lines per sq. in. would be 157 turns for 220 volts or one-half this number of turns for 110 volt operation. He can then see how much space this will require figur-



ing 1000 circular mils per ampere to give him the highest rating in output. This transformer shouldn't draw more than 50 watts idle current. The impedance will be approximately four percent.—J.R.W.

A. TO QUESTION 129. An air-cooled auto-transformer of satisfactory operating characteristics may be designed as follows:

(1) Calculation of total flux:

Let F = Total flux.

A = Cross-section of iron core in square inches.

= 10.5 sq. in.

B = Flux density in iron core in lines per sq. in.

= 50,000 lines per sq. in. for air-cooled transformer.

Then, $F = A \times B$.

= $10.5 \times 50,000$.

= 525,000 lines.

(2) Calculation of number of turns:

Let N = Number of turns between primary terminals.

E = Impressed voltage.

= 220 volts.

f = Line frequency in cycles per second.

= 60 cycles per second.

F = Total flux.

= 525,000 lines.

Since $N = \frac{E \times 100,000,000}{4.44 \times f \times F}$

Then, $N = \frac{220 \times 100,000,000}{4.44 \times 60 \times 525,000}$

= 157 turns.

Volts per turn = $220/157$.

= 1.4.

(3) Calculation of auto-transformer kva:

Let K = a constant.

= 1.5 – 2.5 for good sheet metal.

= 3.0 – 4.5 for poor quality sheet steel.

Substituting in

$$KVA = \frac{F \times F \times f}{K \times K \times 1,000,000,000,000}$$

$$= \frac{525,000 \times 525,000 \times 60}{2.5 \times 2.5 \times 1,000,000,000,000}$$

$$= 2.64 \text{ kva.}$$

(4) Calculation of magnet wire cross-section:

Primary current at full load will be

$$I = \frac{KVA \times 1000}{E}$$

$$= \frac{2.64 \times 1000}{220}$$

$$= 12 \text{ amps.}$$

Allowing 750 circular mils per ampere. Magnet wire size = 750×12 .

= 9,000 CM. Could use No. 10 wire having 10,380 CM.

However, inasmuch as the auto-transformer is intended for intermittent duty and the winding is going



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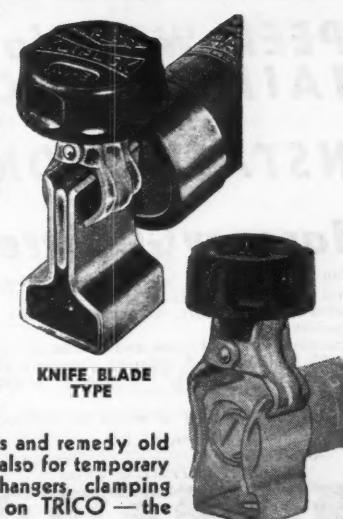
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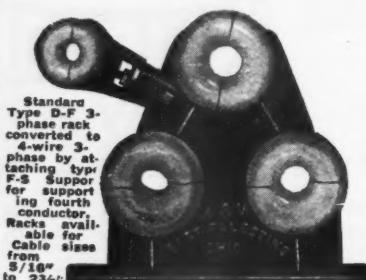
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Standard Type D-F 3-phase rack converted to 4-wire 3-phase by attaching type F-S Support for supporting fourth conductor. Racks available for cable sizes from $\frac{5}{16}$ " to $\frac{23}{32}$ ".

Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bearings.

Send today for Bulletin C-S-51 . . . describes these and other M. & W. items.

Hook-Mounting and Bar-Type Cable Racks • Messenger Wire and "Bull Dog" Conduit Hangers • "Bull Dog" Insulator Supports • Ground Clamps

**THE M. & W. ELECTRIC
MANUFACTURING CO., INC.**
EAST PALESTINE, OHIO

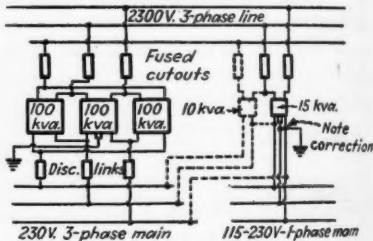
to be wound single layer, 550 CM may be allowed per ampere resulting in a magnet wire of 6600 CM or No. 12 wire having 6530 CM—R.G.C.

OPERATING TRANSFORMERS IN PARALLEL

Q UESTION 130. Our load is seasonal. Five to seven months each year the connected load is 350 hp. of motors, the largest of which is 30 hp. The remaining months the power load never exceeds 20 hp. The lighting and small single phase load is about 20 kw.

Our service is 2300 volt delta metered primary to 3-100 kva. transformers for 3 phase 230 volt power and one 15 kva. transformer for 115-230 volt single phase. Connections are as per solid lines in the sketch.

In order to reduce transformer losses during the off season period we propose to install a 10 kva. transformer in



open delta with the present 15 kva. transformer and switch off the large bank on both primary and secondary, by means of connections as per dotted lines in the sketch.

The question is: Will we run into any trouble trying to run the little open delta bank in parallel with the large closed delta bank?

Certain of our equipment is such that it would be undesirable to interrupt service for even the short time required to switch from one bank to the other.—T.W.J.

A TO QUESTION 130. The two small transformers will not have the same characteristics as the large bank and you will have some circulating currents but this will only last until the secondaries of the large bank are opened.

I see no reason why this cannot be done if the secondaries of the small transformers are properly phased out before closing.

Phasing out can be done with a voltmeter or lamps.

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I would advise opening the large bank secondaries as soon as possible after closing-in small bank.—W.R.T.

A. TO QUESTION 130. There will be no trouble encountered in the parallel operation of the open delta bank with the larger closed delta bank.

This statement is, of course, based on the consideration that the following characteristics exist.

1. The polarity must be the same.
2. All transformers must be of the same voltage ratio.
3. The voltage ratings must be the same in all transformers.
4. The impedance must be the same or nearly so.
5. The regulation must be nearly identical in all units.
6. The phase rotation and angular displacement must be the same.

As the internal connections in the drawing accompanying the question are not shown, it is not possible to determine whether the connections are correct or not. However, it would appear that the right hand secondary lead of the 15 kva. transformer, which is shown grounded, is actually hot, or at a potential different from that of ground. It is important that the center tap of the secondary of this transformer be connected to the case and to ground.—G.S.E.

A. TO QUESTION 130. In order to operate transformers in parallel satisfactorily, the transformers must not only have the same voltage ratio and the same impedance value, but also must be of the same polarity and have the same voltage characteristics. That is, the instantaneous voltages of two transformers in parallel must be the same so that there will be no circulating current. Also the voltages must be the same at full load, at no load, and at points between them so they will divide the load in proportion to their capacity.

The sketch with the question shows an arrangement which might cause trouble but this may be due to a slight error in making the sketch which indicates that one of the large transformers is grounded at the mid-point of the transformer winding while the ground on the small 15 kva. transformer is connected to one of the outside wires. This does not seem right since it would be desirable to have the middle wire of the 115/230 volt single phase lighting circuit grounded. Before the final connection can be made, it will be necessary to be sure not only that the transformers to be connected together are connected to corresponding phases, but also to be sure that they are of the same polarity so that there



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490 S. MILL STREET

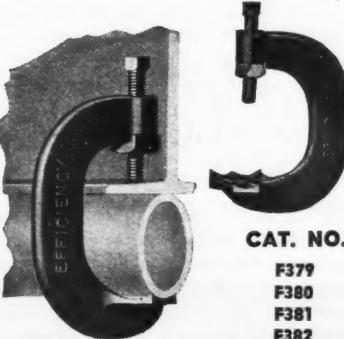
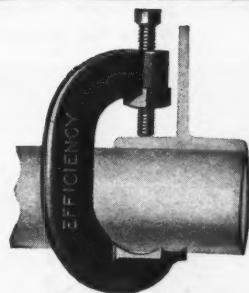
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NEW CASTLE, PA.

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- The most practical and widely adaptable hanger ever devised for supporting conduit or armored cable on open steel construction. Will carry pipe at any angle to beam.



Highest grade malleable iron, guaranteed against breakage. Set screw, cup pointed, tightened by free nut, plus 5-point radiating ridges of gripping surface holds pipe on true mechanical principle, guaranteeing a solid, non-slip support.

CAT. NO.

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For armored cable
For 1/2" and 3/4" conduit
For 1", 1 1/4" and 1 1/2" conduit
For 2" and 2 1/2" conduit

WRITE TODAY for our Catalog No. 38 . . . contains complete information on this and other EFFICIENCY Electrical Devices

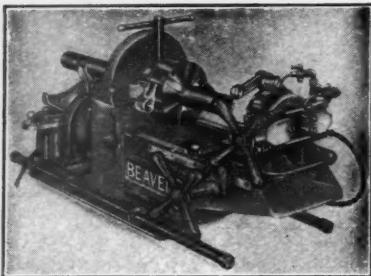
MANUFACTURERS OF EFFICIENCY
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WIRE AND CABLE SUSPENSION

Efficiency
ELECTRIC AND MANUFACTURING CO.



The A-B-C of . . .

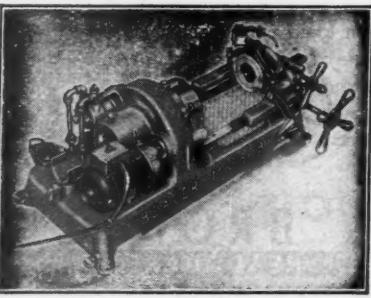
Pipe and Bolt Machines!



Beaver Model-A

A high-speed heavy-duty deluxe Pipe and Bolt Machine. Range $\frac{1}{8}$ to 2-inch up to 12-inch with geared tools and drive shaft. Bolts, $\frac{1}{4}$ to 2-inch. Wt. 415 lbs.

Write for Bulletin A



Beaver Model-B

A light-weight utility Pipe and Bolt Machine combining many features of Model-A with the easy portability of Model-C. Range $\frac{1}{8}$ to 2-inch up to 8-inch with drive shaft and geared tools. Bolts up to $1\frac{1}{2}$ -inch. Weight 280 lbs.

Write for Bulletin B



Beaver Model-C

A STURDY LITTLE POWER UNIT Converts hand pipe tools into power tools from $\frac{1}{4}$ to 8-inch. Threads 8-inch in 6 minutes. Threads bolts up to $1\frac{1}{2}$ -inch. Two men can work at the same time without interference. Weight 150 lbs.

Write for Bulletin C

Write for new Tool and Machine Catalogue—Just off the press

**BEAVER
PIPE TOOLS**

442 Deen Ave. Warren, O.

will not be any difference of potential between the leads when the connection is made. This can be tested by using a set of test lamps capable of withstanding twice the normal voltage. After the test has been made, if we find that there is no voltage difference, it would be desirable to put a small fuse in each of two connections before the switch is closed. If this is done, any unbalanced voltage or any error in connection which might result in a heavy circulating current will blow the fuse and so avoid trouble.

After this test has been made and shows no difficulty, permanent connections can be arranged. It would be desirable, of course, to have a fused disconnect switch between the small secondary and the 3 phase main.—J.E.W.

Can you ANSWER these QUESTIONS

QUESTION Q5 —On a recent construction job I have installed several current transformers of a new design which consists of a coil of wire which is installed by slipping over one of the conductors to be metered. The conductor itself acts as the primary or core of the transformer. This coil as the secondary. Now as everyone knows the old fashioned conventional type current transformer, if open circuited under load, would build up a very high potential on the secondary winding causing damage to the transformer itself and which is also hazardous from a safety angle. Would this condition occur with the new type of transformer which I have described above?—D.O.

QUESTION R5 —In cases of emergency would the same protection be attained by using two fuse links, paired together in the same holder, as using a single fuse link of the correct size? For instance, a 10 and 15 amp. link used in place of a 25 amp. link.—J.A.H.

QUESTION S5 —I would like information, or a formula, on how to select the proper size water heater for a 66 gal. insulated water tank. This tank is in the basement of a 23 patient hospital. I have installed a two kw., but it supplies hot water for only the first two hours in the morning and is lukewarm the rest of the day. I believe the tank is too small for the number of people. They drain it faster than it can heat.—M.Z.

PLEASE SEND IN
YOUR ANSWERS BY MAY 1

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TRIPLOC

Midget Triploc
cord connector



Interchangeable contact units—
male and female types available



2 pole 3 pole 4 pole

compact, heavy duty plugs and receptacles

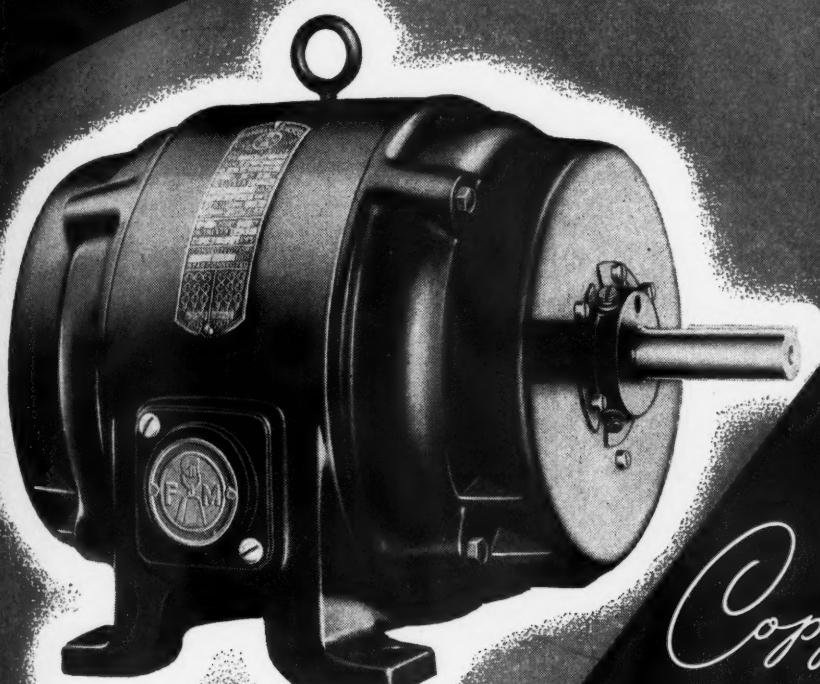
● Midget Triploc plugs and receptacles are ideal for use with a great variety of portable electrical equipment where operating conditions are severe. Interchangeable 2, 3, or 4 pole contact units permit many different types of assembled combinations. The protected female contacts may be assembled in either plug shell or receptacle housing for protection in line side of circuit. Automatic bayonet lock is simple and effective; polarity is maintained and correct insertion of plug assured by unequal spacing of contacts. Ground protection is provided. Write for General Catalog 1100 with complete listings of all types. Rating 10A, 250V., 15A, 125V.

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Copperspun

ROTOR

Here is the new Fairbanks-Morse general purpose, continuous duty motor—designed for the future—available now! Never have more stamina, versatility and protection been built into a motor housing!

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NOTE THESE FEATURES

- It is a 40°C. motor.
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- It has an optional conduit box assembly.
- It has cross-flow ventilation.
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- It has exclusive Fairbanks-Morse COPPERSPIN ROTOR.

Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

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PUMPS SCALES
MOTORS STOKERS
GENERATORS FARM EQUIPMENT
RAILROAD EQUIPMENT



Motors



Answered by
F. N. M. SQUIRES
Chief Inspector New York Board of Fire Underwriters

QUESTIONS ON THE CODE

FIBER CONDUIT

Q. "We are contemplating a trial installation of fiber conduit which will be part of an outdoor exposed system enclosing cables carrying 2300 volts. Would this be permissible?"—M.E.R.

A. Fiber conduits of four manufacturers are listed by Underwriters' Laboratories under "Conduit—Non-Metallic".

Two of these manufacturers have the non-metallic conduit listed "for use underground" and all four have non-metallic conduit listed "for use in central stations or underground when laid with its entire length in concrete".

The National Electrical Code does not recognize fiber conduit as an approved wiring material for exposed work but does provide applicable rules, in Section 354, for its use as an underfloor raceway "when installed beneath the surface of concrete or other flooring material".

Of course, if there is contemplated a trial installation of exposed work which would not be in compliance with the Code the local inspection department having jurisdiction should be consulted.

MOISTURE SEALS

Q. "We will appreciate knowing code requirements or standard practice for the following condition:

"Three conductors, varnished cambric, lead sheathed cables carrying 3 phase, 60 cycle, 440 volt current terminate in drip proof cabinets which are provided with conduit couplings welded to the cabinets. After the three conductors have been separated and fastened to the equipment in the cabinet, should any provisions be made to seal the cable at the point where the three conductors enter the lead sheath? In other words should the lead sheath

at that point be belled out and sealing compound be used to minimize absorption by the insulation exposed at that point? The rooms in which these cabinets occur are subject to extreme moisture and humidity conditions."—H.P.

A. The rules of the National Electrical Code do not require the sealing of the ends of lead covered insulated conductors for voltages of 600 or less. For voltages of more than 600 volts between conductors, section 7115 of the Code requires that "where conductors emerge from a lead sheath they shall be protected from moisture and mechanical injury by a pothead or by other means which will give equivalent protection."

While such protection or sealing is not required for voltages of not over 600 it would be very good practice to provide sealing at the ends of the lead sheath in locations where excessive humidity or moisture exists.

In a single conductor lead covered varnished cambric wire while there is not very much air inside of the lead covering, there is still some. In the multiple conductor lead covered wires there is quite an appreciable amount of air within the assembly.



NEW CHAIRMAN of the Illinois Chapter, International Association of Electrical Inspectors, Newton Mosser (left), Chicago, takes over the duties of retiring chairman C. M. Parks at recent Chapter annual meeting in Chicago.

In the normal operation of circuits the conductors do warm up when carrying current; the more current the more heat developed. When they heat up the air within, the assembly expands and is expelled. Then when the load, and thus the current, is removed from the circuit the conductors cool off and air is "breathed" into the assembly. Of course, if there is excessive moisture in this air it also is drawn into the assembly and will collect there by condensation as moisture.

Some of the wire manufacturers recommended that the ends of lead covered cables be sealed by means of some sort of sealing compound, wax, or insulating varnish. Such treatment can take care of the situation without resorting to a pothead where the voltages are below 600.

COMBUSTIBLE MATERIAL AT OUTLET

Q. "The second sentence of section 3707 of the 1940 Code reads as follows: 'If a fixture canopy is used, any combustible wall or ceiling finish exposed between the edge of the canopy and the outlet box shall be covered with non-combustible material'. To my knowledge I have never seen this rule enforced, and would like to have some suggestions as to how this would be accomplished economically."—C.F.S.

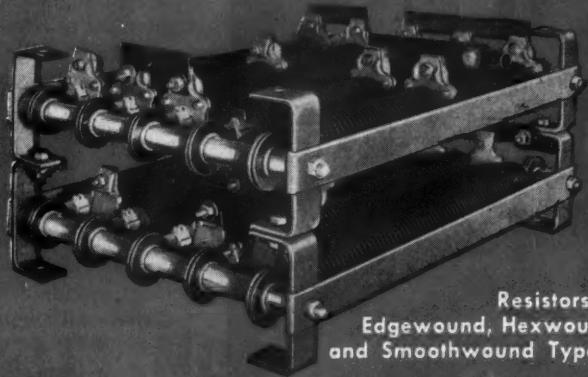
A. What is probably the safest way to meet this requirement is to have a "metal to metal" fit between the outlet box and the fixture canopy.

The history of this rule is interesting and shows the intent of it. The 1933 Code required that "Fixture canopies used in lieu of covers at outlet boxes shall provide a continuous metal to metal fit or equivalent) with the rim of the box whenever the wall or ceiling finish is of combustible material.

REQUIRE STANDARD EQUIPMENT?



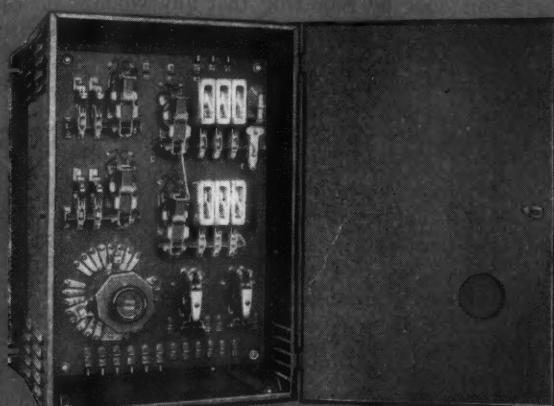
Push Button Control Stations of all types in General Purpose, Watertight and Weatherproof enclosures.



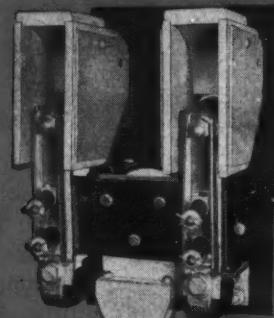
Resistors—
Edgewound, Hexwound
and Smoothwound Types.



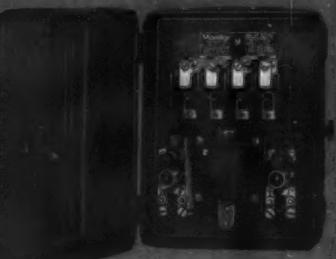
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of magnetic switches.



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Contactors for A.C. and D.C.



A.C. and D.C. Motor Starters . . .
across the line, reversing and non-reversing and in combination units.

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The standard units shown here, plus the many other units that make up the complete Monitor line, are used by Monitor engineers in designing and fabricating



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the custom-built Monitor units that are in evidence in hundreds and hundreds of industrial plants, office and public buildings, printing plants, commercial laundries . . . all over the country. These units play their part well in Monitor custom-built equipment . . . they will perform equally well for you.

See the Monitor field engineer, he will assist you in all problems of automatic motor control.

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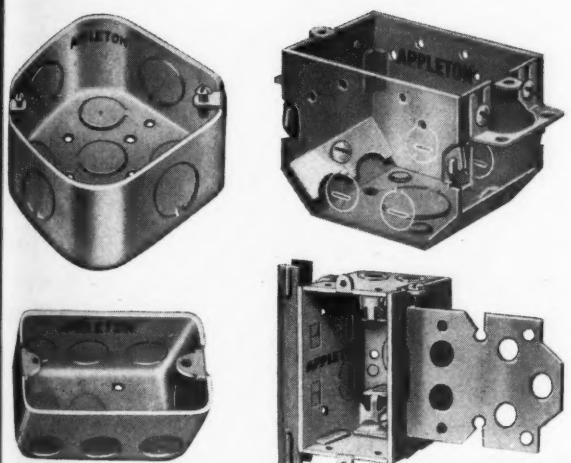
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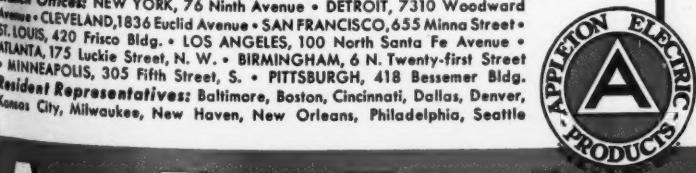
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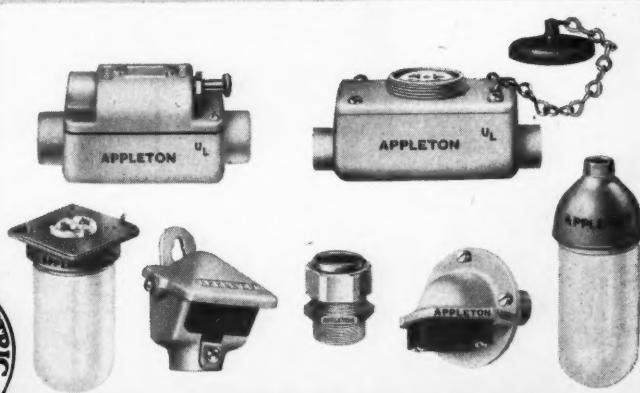
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SPECIAL "REA" CONDUIT FITTINGS

For Dependable, Weather-Tight Farm Wiring



A NEW Westinghouse

The increased use of instant starting ballasts for 40 watt lamps has developed the need for a lamp which will operate satisfactorily on such ballasts. Westinghouse engineers have now perfected a lamp for this purpose.

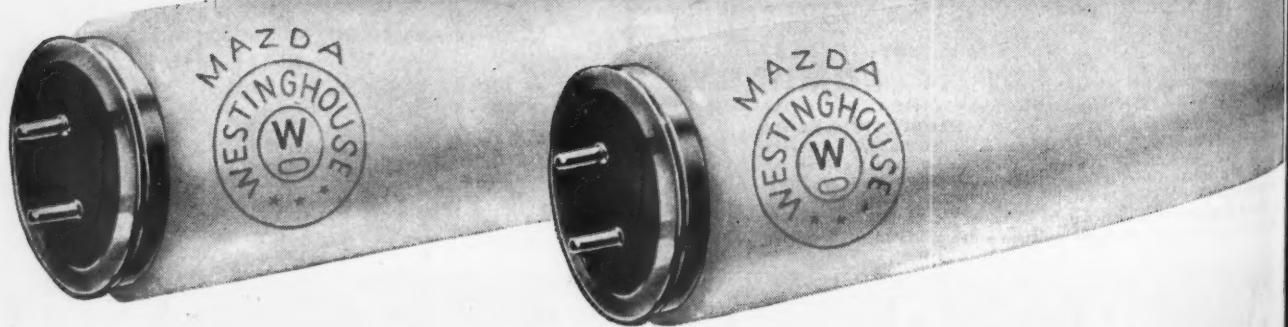
This new 40 watt white Westinghouse Mazda Fluorescent lamp will have the same rated life when operated on the instant starting ballast that the standard 40 watt Westinghouse Mazda Fluorescent lamp now has when used with conventional ballasts and starters.

It should be ordered only for use on the instant starting ballast and should not be ordered for use in installations having preheat starting. It will be

specially marked and will have the same list price as the standard lamp. Limited quantities of these lamps will be available for shipment on and after May 1, 1944.

New developments such as this typify the skill and resourcefulness of Westinghouse engineers. Based on a persistent policy of product improvement, they are the reason why the name "Westinghouse" has come to mean leadership in lighting.

They are the reason, too, why it pays to recommend Westinghouse Mazda Lamps for every lighting application and installation. Westinghouse Elec. & Mfg. Co., Bloomfield, N. J. *Plants in 25 cities . . . offices everywhere.*



e FLUORESCENT LAMP



LET'S ALL KEEP BACKING THE ATTACK...BUY MORE WAR BONDS

PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Circuits of Electronic Controls—III

The thyratron is used to obtain infinite speed control of d.c. motors from a.c. power supply. Phase-shift heat control of resistance welders is also discussed in this third article on circuits.

BY setting up the proper circuits and by using the thyratron tubes as converters, d.c. motors can be operated from an a.c. power supply. The complete circuit can be broken down into two basic supply circuits, namely the armature and the field. Auxiliary circuits are added to shift the phase-angle of thyratron firing which in turn varies the available armature and field voltages from nearly zero to a maximum. An additional circuit is used to obtain current-limit and full-field during starting periods. A compensating circuit is added to prevent speed drops during load changes.

7—Operating a D.C. Motor on A.C. Power Supply

The operation of a d.c. motor from an a.c. power supply is quite different from the preceding examples of electronic control. If a simple two-tube rectifier is used as shown in Fig. 23,

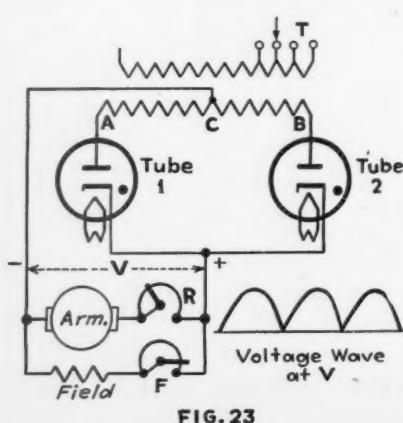


FIG. 23

By G. M. CHUTE

Application Engineer,
General Electric Company,
Detroit, Mich.

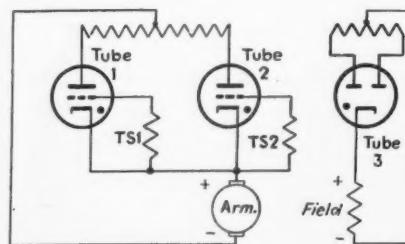


FIG. 24

the motor speed cannot be controlled except by a series rheostat R, a field rheostat F, or by changing the tap of transformer T. Tubes 1 and 2 have no grids, so they act merely as valves; during the half cycle when the transformer winding is more positive at A, the voltage between A and C forces current to flow through tube 1, through the motor and back to C. During the next half cycle, when the transformer winding is more positive at B, the voltage between B and C forces current to flow through tube 2, through the motor and back to C. Since tubes 1 and 2 are vapor-filled, the voltage drop from anode to cathode is only about 15 volts; the remainder of the voltage (A to C, or B to C) appears across the load at V. These tubes cannot control or change the amount of voltage at V.

Controlling Motor Speed by Thytrons.

In Fig. 24, two rectifier tubes again

supply pulsating direct current to a motor armature. These tubes are thytrons, and can be controlled by their grids so as to change the average voltage applied to the motor armature, and thereby control the motor speed. Meanwhile the motor field receives its constant current through a separate rectifier, tube 3.

Since tubes 1 and 2 are of the vapor-filled type (so as to be able to conduct the large current required by such a motor load), the instantaneous amount of current flowing through these tubes at any instant depends entirely on the a.c. supply voltage and the motor load circuit. The grids can merely "tell" each tube when to start passing this current; that is, the grid can prevent the tube from "firing" or conducting anode current, until some desired point in each wave of applied a.c. anode voltage. For example, Fig. 26 shows the a.c. anode voltage which is applied to tubes 1 and 2. The grid voltage (supplied by transformers TS1 and TS2 in Fig. 24) is nearly in phase with the anode voltage; that

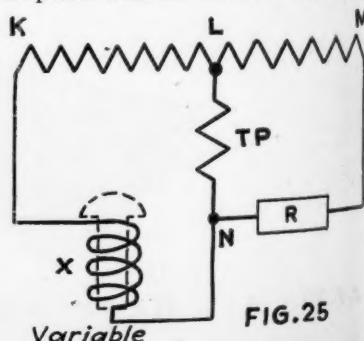


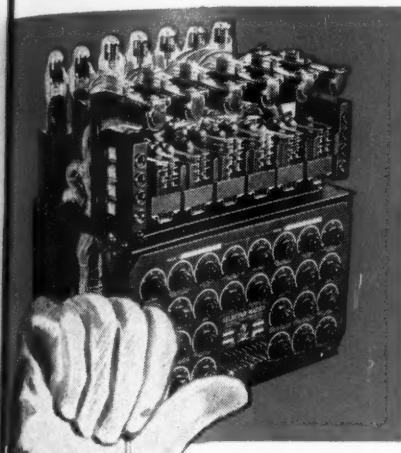
FIG. 25

aintenance of
tribute items
e paid for.

How RCA Electron Tubes



Direct Traffic!



The ELECTRO-MATIC's magic brain that helps fight "Sudden Death" is the group of 7 RCA electron tubes shown top rear: 2 full-wave high-vacuum rectifiers (RCA 6X5-G), and 5 thyatrons (RCA 885).

THIS morning on your way to work you drove past "Dead Man's Corner." Few people still remember it as that. But the little Reilly girl whose father was the traffic cop there until they brought him home one night, dying...the mother of Dick Stone who drove the truck for Clark's...Ben Thompson's widow.* They'll never think of it by any other name.

Today these danger spots are growing safe — through electronic devices like the "Electro-Matic" traffic regulator developed by Automatic Signal Corp.

Buried below the pavement at busy intersections is a sensitive magnetic detector coil that clocks traffic on each approaching highway and flashes the information to a master control center. Here, through the magic of RCA electron tubes, the volume, speed, and direction of traffic, spacing of vehicles, number of cars waiting, probabilities of arrival are all automatically analyzed and the one correct solution instantly put into operation through proper traffic light signals

at each converging highway.

These control devices have reduced accidents substantially, cut down waiting time on the red light, and increased the capacity of overburdened intersections.

If your community could benefit from such a system, ask your local Safety Committee to get in touch with Automatic Signal Corp., Norwalk, Conn.

And if you believe electronics can do some counting, sorting, measuring, or control job in your industrial plant better, faster, or more accurately than by existing methods, write to us. We will gladly refer you to the equipment manufacturer best fitted to serve you. Or our tube engineers themselves may be able to help you — for the Magic Brain of all electronic equipment is a Tube — and the fountain-head of modern tube development is RCA. So merely write, stating your problem, to RCA, Commercial Engineering Section, 607 South 5th St., Harrison, New Jersey.

*Fictitious names, of course.



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WAR
BONDS

RADIO CORPORATION
OF AMERICA

is, the curve of grid voltage crosses the cathode line at A, almost the same spot where the anode-voltage curve meets the cathode line. As a result, the tubes begin to conduct current at point A in each half cycle, so voltage is applied to the motor armature during nearly the entire time.

However, if the curve of grid voltage is "phase-shifted" (by a circuit explained below) or moved to the position shown in Fig. 28, the grid is more negative than the cathode during the

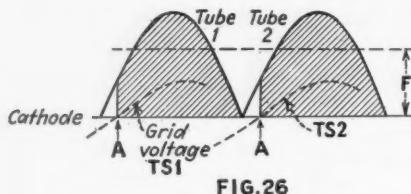


FIG. 26

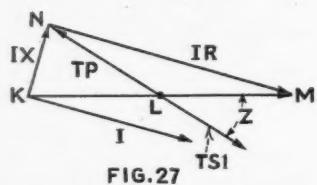


FIG. 27

first part of each half cycle, from B to C and from D to E, so the tubes are prevented from conducting anode current until points C and E. Voltage is applied to the motor armature during the shaded part of each half cycle. The average value of this jagged voltage wave is G (as read on a d.c. voltmeter); notice that G is a smaller amount of voltage than F (as read on a d.c. voltmeter, in Fig. 26).

If we now phase-shift the grid voltage still farther, as shown in Fig. 30, until the grid-voltage curve crosses the cathode line quite late in the half cycle, the tubes do not begin to conduct until point J; the voltage applied to the motor armature during the small shaded portion has a very low average value H.

The Phase-Shifting Circuit

The phase-shifting of grid voltage (of tubes 1 and 2 in Fig. 24, by means of transformer windings TS1 and TS2) is accomplished by the circuit

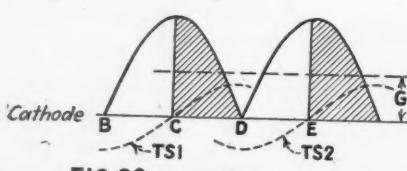


FIG. 28

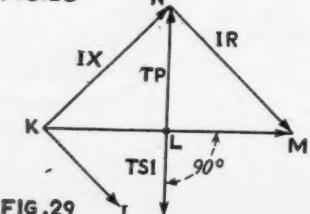


FIG. 29

in Fig. 25. Here we find the primary winding (TP) of the grid transformer, connected in the center of a bridge circuit; this circuit receives a.c. power from transformer winding KM (from the same source which supplies anode voltage to tubes 1 and 2). Connected between K and M are a constant resistance (R) and a reactor (X); here X is in the form of a solenoid whose iron armature or core can be withdrawn from the magnet coil. Withdrawing the core decreases the amount of iron which is effective. With less iron, the reactor has less inductance; that is, it is less able to prevent the flow of alternating current through its winding.

Starting with the core withdrawn from the solenoid (X) in Fig. 25, the resulting small inductance of X permits considerable current to flow through X and resistor R. This condition is shown in the vector diagram of Fig. 27; current I nearly in phase with the supply voltage KM; a large voltage drop IR across the resistance, a small voltage drop IX across the solenoid. Connected between junction N and midtap L is the grid transformer, whose primary voltage (TP) fits in the vector triangle as shown in Fig. 27; the secondary winding TS1 is connected so that its output voltage (at the grid of tube 1) lags behind the supply voltage by the small angle Z. This condition produces the wave shapes shown in Fig. 26.

If the core of solenoid X (in Fig. 25) is inserted part way into the coil, the inductance is increased until the voltage drop across X is as large as the voltage drop across R, as shown in Fig. 29. Here TS1 is seen to lag 90 deg. behind the supply voltage; this produces the wave shape shown in Fig. 28. Notice that this increase of inductance of X has phase-shifted or retarded the grid voltage curve of tubes 1 and 2, thereby decreasing the average motor voltage from F (Fig. 26) to G (Fig. 28). Similarly, further insertion of the solenoid core produces the conditions of Fig. 31 and Fig. 30, reducing the motor armature voltage to H. With this method, the speed of a motor is easily controlled by moving a solenoid core, such as occurs in the automatic control of tension when reeling wire.

Control by a Saturable Reactor

In many recent phase-shifting circuits, the movable-core reactor of Fig. 25 is replaced by a saturable reactor, a device whose amount of inductance is easily changed without moving any part. Instead of physically withdrawing the iron, we change the

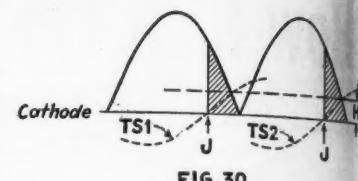


FIG. 30

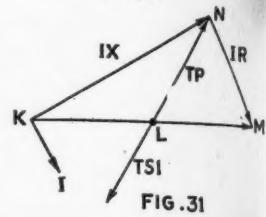


FIG. 31

inductance of the saturable reactor by means of saturating its iron. To make this possible, the saturable reactor includes not only a main a.c. winding, but also a separate winding through which direct current may flow. Fig. 32 shows such a reactor (SX) substituted in the phase-shifting circuit of Fig. 25.

Fig. 32 includes a small rectifier tube A, whose output current passes through the d.c. winding of saturable reactor SX (although other d.c. sources may be used for this purpose). With rheostat VT turned to insert all its resistance, the amount of direct current flowing is too small to affect SX, which therefore has maximum inductance. However, when the rheostat is turned, increasing the flow of current in the d.c. winding of SX, the inductance of SX decreases, producing the condition shown in Fig.

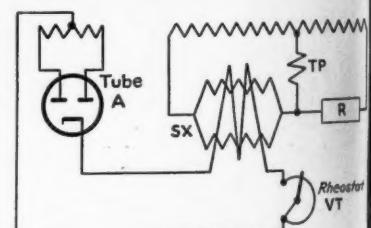


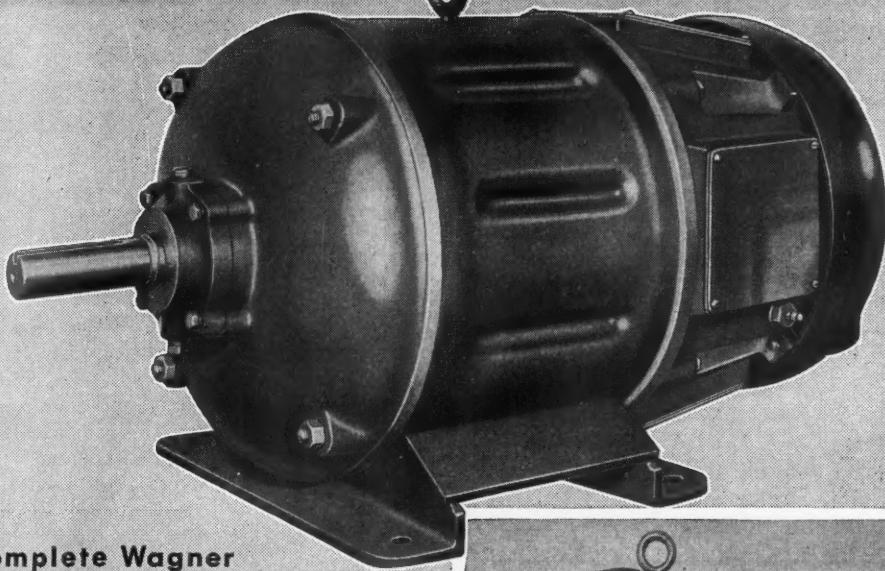
FIG. 32

30. As we increase this d.c. saturation current further, the decreasing inductance of SX advances the curves of grid voltage, producing first the conditions of Fig. 28, and then Fig. 26. Notice that an increase of direct current in SX produces a corresponding increase of average voltage at the motor armature.

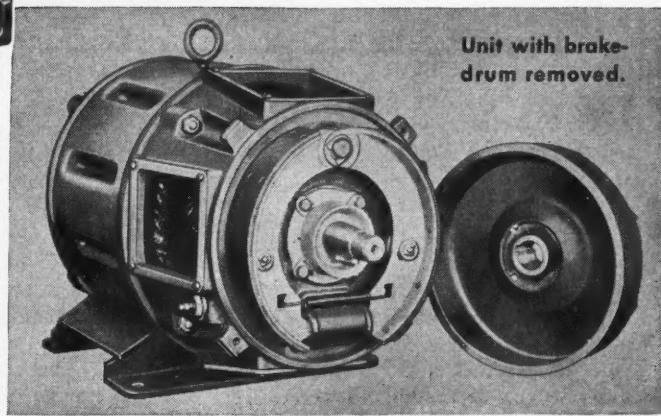
The iron-core saturable reactor (SX) is so designed that the iron loses its inductive effect when even a few milliamperes of direct current flow through the many turns of its saturating winding. This small amount of current can easily be conducted and controlled by a small vacuum tube, and we next study the motor-control circuit wherein high-vacuum tubes are used in place of rheostat VT of Fig. 32.

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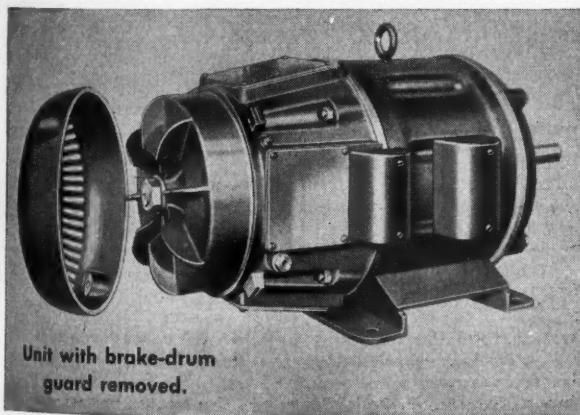
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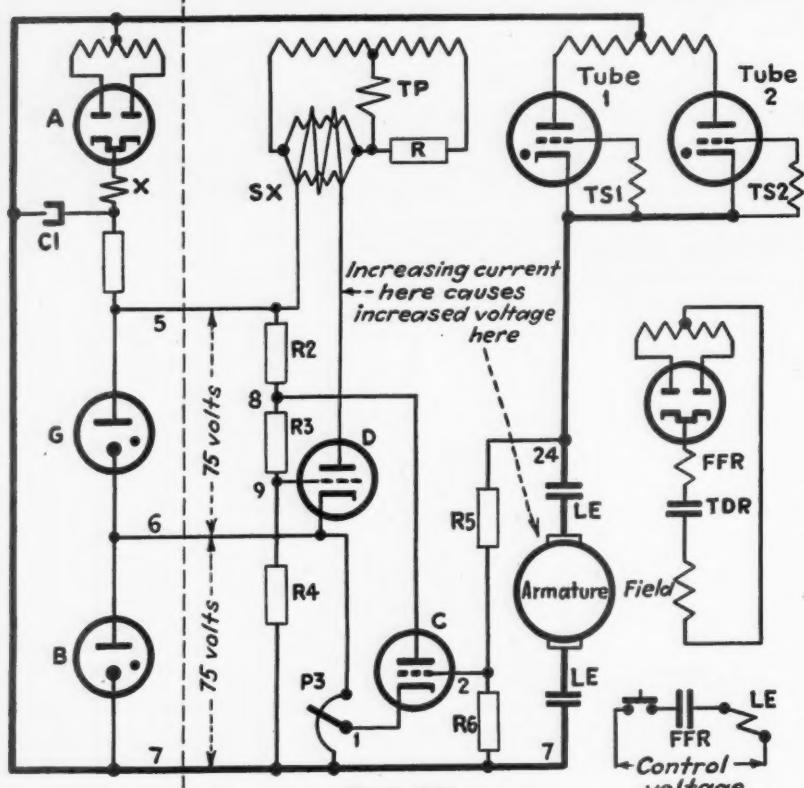


FIG. 33

8—All-Tube Regulation of D-C Motor-Armature Voltage

When we wish to adjust the speed of a d.c. motor and then hold that speed constant, we know that the voltage supplied to the motor armature must be accurately regulated. This regulation is accomplished by the circuit of Fig. 33, which combines the circuits of Figs. 24 and 32 with an additional pair of vacuum tubes (C and D). We will see that, if the armature voltage changes, tubes C and D will immediately cause tubes 1 and 2 to restore the armature voltage to normal.

To obtain the needed accuracy of tube response, Fig. 33 first supplies a closely-regulated source of d.c. voltage. At the left side of Fig. 33, the rectified output of tube A is filtered by reactor X and capacitor C1; voltage-regulator tubes (G and B) (previously described in Fig. 22) are used to hold constant voltage between points 5 and 7. Tube G is designed to hold 75 volts between points 5 and 6; duplicate tube B similarly holds 75 volts between points 6 and 7. The 150 volts between points 5 and 7 is applied to the voltage divider R2, R3 and R4; notice that this divider is not connected to point 6.

Before the motor can start, the tubes must be given sufficient time to become hot; this heating time is assured by a 5-minute time-delay relay whose contacts close the motor field circuit (see TDR in Fig. 33). The

flow of field current picks up FFR (field-failure protective relay) which closes its contact in the motor-starting circuit. To start the motor, contactor LE connects the motor armature to the d.c. output of tubes 1 and 2.

The desired motor speed is selected by turning potentiometer P3 (whose slider is connected to the cathode of tube C). The resulting motor speed depends on the armature voltage (between points 24 and 7); part of this

armature voltage appears across R6 of a voltage divider and is connected to grid 2 of tube C. Tube C, after "being told" at its cathode what motor speed is desired, is kept informed at its grid as to whether the motor speed is correct.

Watching the Circuit Regulate the Armature Voltage

Suppose the speed dial (P3 in Fig. 33) is set at a high-speed position, where 65 volts exist between slider 1 and point 7. If the armature voltage is too low to produce this desired speed, the portion of the armature voltage across R6 will be much less than 65 volts; grid 2 is much more negative than cathode 1, so no anode current flows in tube C.

Notice that the tube C anode is connected to a voltage divider at point 8; resistors R2, R3, and R4 have such values that the voltage drop across R4 is about 75 volts when there is no tube C current; therefore the grid potential of tube D is at a potential equal to that of point 6 (cathode of tube D); having no grid bias, tube D conducts enough anode current to saturate SX and thereby increase the average voltage which tubes 1 and 2 apply to the motor armature.

When the motor armature voltage increases, the voltage across R6 increases also, and raises the potential of grid 2, thereby "turning on" tube C. Notice that any tube C current flows from point 5 through R2, anode to cathode of tube C, through P3 to point 7. As the tube C current increases, a larger voltage drop appears across R2, with a corresponding decrease of voltage across R4, which

CURRENT FLOW

IT IS NOT surprising that the February article has caused readers to revive the question whether current flows from anode to cathode, or flows from cathode to anode.

Existing American Standard Definitions of Electrical Terms, as now followed by the electrical industry, indicate that "positive current" flows toward a point of lower or more negative potential, as from anode to cathode. Perhaps these standards should be reworded to agree with evidence presented by the field of electronics.

We may agree that electrons flow from the cathode to the anode or to the grid. Whether the current flows in this same direction or in the opposite direction is merely a mental picture or a definition. When explaining an electronic circuit, we can present a more accurate picture by letting the current flow in the same direction as the electron flow.

However, before we teach or state that current flows from cathode to anode, and toward a point of more positive potential, we must not only revise the A.S.A. standards; we must substitute the left hand into Fleming's "right-hand generator rule of field, current and motion", and in similar ways reorient many of the basic statements in elementary physics. Some texts have already included these changes, but they carefully speak in terms of electron flow.

While present standards exist, we confuse the issue if we introduce cathode-to-anode current to the electrical technician who has been weaned on positive-to-negative flow of current.

We who talk of anode-to-cathode current may be driving on the left-hand side of the road; although we may prefer to drive on the right-hand side, we will continue to avoid cathode-to-anode current until it becomes standard.—G. M. C.

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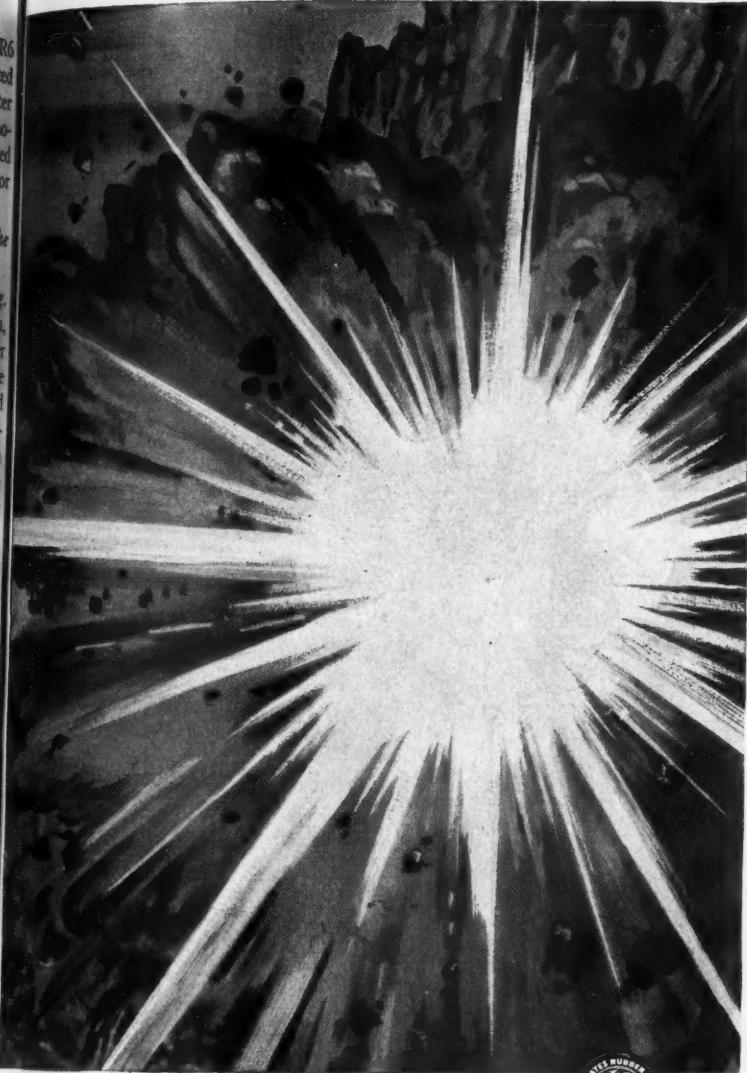
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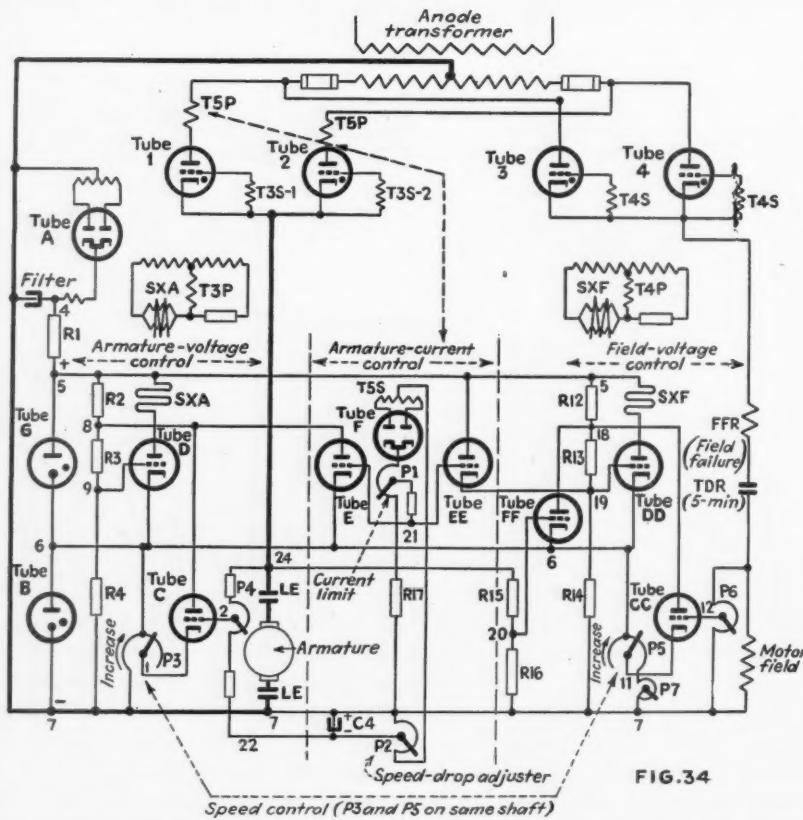
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lowers the potential of point 9, grid of tube D. We see that turning on tube C turns off tube D, thereby decreasing the saturation of SX, turning off tubes 1 and 2 and decreasing the voltage applied to the motor armature.

When we wish to decrease the motor speed, turning slider P3 toward point 7, this action lowers the cathode potential at 1, increases the current flowing through tube C and R2, decreases the current flowing through tube D and thereby phase-shifts tubes 1 and 2 to produce a lower armature voltage. With this new setting of P3, the circuit continues to regulate or phase-shift tubes 1 and 2 until the grid of tube C reports that the motor armature voltage has reached the desired value.

Voltage Regulation by Combined Armature and Field Control

While some tube-operated motors are controlled only by the armature-voltage circuit just described, greater speed range is provided by the circuit of Fig. 34, which provides additional speed control by weakening the motor field. Notice that the armature-voltage control (left-hand portion of Fig. 34) has already been described. The motor field receives its direct current from a separate pair of thyratrons (tubes 3 and 4), which are phase-shifted in the same way as the armature tubes (1 and 2). The field-voltage-control circuit is a duplicate of the armature-control portion, and operates from the same d.c. supply (points 5, 6, and 7).

Tube CC balances the fixed portion of the field voltage (between points 12 and 7) against the desired field voltage as set by P5. An increase of tube CC current causes larger voltage drop across R12 of the voltage divider; the lowered potential at 19 decreases the current through tube DD and the saturating winding of SXF, and thereby decreases the voltage which tubes 3 and 4 apply to the motor field.

Speed-controls P3 (armature) and P5 (field) are mounted on a common shaft, operated by a single dial. The right-hand half of P3 and the left half of P5 have almost zero resistance. Turned counter clockwise, the dial produces low motor speed, for the armature voltage is almost zero while the motor has full field; (tube C is full "on", tube CC is all "off"). Turning the dial clockwise gradually increases the armature voltage but has no effect on the field voltage until the midpoint is reached. Turning beyond midpoint causes no further increase in armature voltage but weakens the field, causing further increase in motor speed.

Operation with weakened field adds the problem of higher voltage generated by the motor armature if the speed dial is suddenly lowered from the high-speed position. Tube FF is added to the field-voltage-control circuit; its grid is connected to resistors R15 and R16 across the motor armature. As long as the armature voltage is less than 300 volts (for a 230-volt motor), there is much less than 75

volts across R16; the grid of tube FF is quite negative and no anode current flows. However, if sudden field-strengthening causes the motor to generate more than 300 volts (since the motor does not "pump back" through tubes 1 and 2), the increased voltage across R16 raises the grid potential of tube FF so that current flows through tube FF and R12; this decreases the current of tube DD and decreases the field current merely enough to keep the armature voltage below the desired limit.

Current-limit Control of the D.C. Motor

The circuits in Fig. 34, discussed thus far, all have responded only to armature voltage or field voltage. In addition, most recent electronic motor controls respond to the amount of motor-armature current, so as to prevent a flow of current greater than some preset amount. Such armature-current control is included in the central portion of Fig. 34. So as to know how much armature current is flowing, two transformer primary windings (T5P) are added above tubes 1 and 2; when current flows through tubes 1 and 2, a corresponding current (a.c.) flows in the transformer secondary (T5S). Tube F rectifies this current into pulsating d.c., which flows down through P1, R17, P2 and back to the center tap of T5S. When there is no motor armature current, point 21 is at the potential of point 7. However, when current flows through T5S and tube F (in direct proportion to the armature current), this current causes a voltage drop across R17; the potential rises at P1 and point 21 (the grid of tube E and tube EE).

If P1 is adjusted to give a "current limit" of about 150 percent of motor full-load current, tubes E and EE have no effect at lesser armature currents. However, with more than 150 percent armature current, both E and EE come into action. Tube E draws additional current through R2 so that tube D decreases the saturating current of SXA; the resulting decrease of armature voltage also decreases the armature current. However, tube EE gives an opposite action; instead of decreasing the field voltage, EE is connected so its current passes through R14, thereby raising point 19, increasing the field voltage and current. We see that excessive armature current causes tube E to turn off tube D (and decrease armature voltage), but makes tube EE turn on tube DD (and increase the field current). This action limits the inrush current when starting the motor, and also assures full-field starting even



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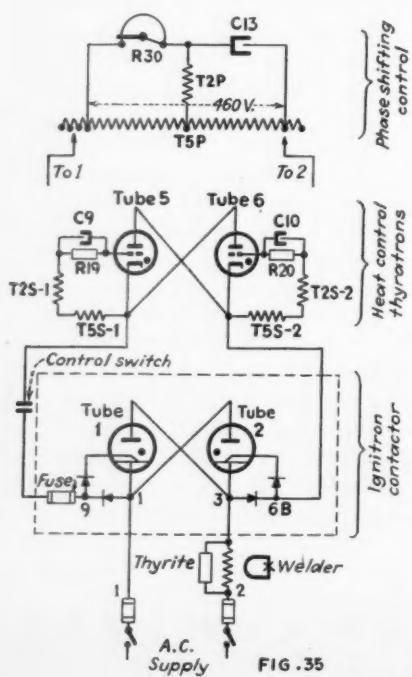
though the speed dial (P5) is in a high-speed weak-field position.

Preventing Speed Drop During Load Changes

The circuit of Fig. 33, while holding constant voltage at the motor armature, does not assure constant speed during changes of motor load. We know that a d.c. motor's speed usually changes when the load changes, because of the internal voltage drop (IR drop) of the motor. However, Fig. 34 includes a "speed-drop adjuster" at the bottom of the armature-current control. The voltage across P2 increases as the motor load increases; such increase causes the P2 slider (point 22) to be more negative than the top, point 7. This P2 voltage is placed in series with P4 (across the motor armature) so that, as the increasing motor load lowers the potential at point 22, the grid of tube C is likewise lowered. Even though the armature voltage has remained constant, the increased motor load causes a decrease of the tube C current, which causes tube D and tubes 1 and 2 to apply greater voltage to the motor armature. By adjusting P2, the motor speed is made to remain constant despite load changes.

The circuit of Fig. 34 demonstrates a combination of high-vacuum tubes and vapor-filled tubes to produce better motor performance. Both types of tubes are made to give gradual stepless variation of output; the vapor-filled tubes require the use of phase-shift of the grid voltage, to produce such variable output.

9—The Phase-shift Heat Control of Resistance Welders



Another important use of phase-shifted vapor-filled tubes is in the heat control of welders. Fig. 35 shows two thyratron tubes (5 and 6) arranged to control and "fire" ignitron tubes 1 and 2, which are used in an ignitron contactor previously described (Fig. 20). By itself, the ignitron contactor will apply either full voltage or no voltage to the welding transformer; the welder produces full heat at the weld, or no heat. By adding thyrtatrons 5 and 6, the ignitrons are made to give stepless variation of the voltage applied to the welding transformer, producing gradual heat control of the welder.

Current may flow through tube 5 only when the a.c. supply line (2) is

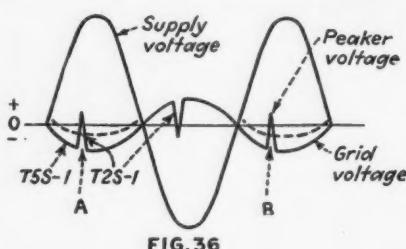


FIG. 36

positive; this current flows from 2 through the welding transformer to 3, through the metallic rectifier to 6B, through tube 5, the control switch and the fuse to point 9, into the ignitor of tube 1, to line 1. We see that tube 5 fires ignitron 1; tube 6 fires ignitron 2 during the other half cycle.

In Fig. 35, the grid circuit of tube 5 is a duplicate of the tube 6 circuit; each grid circuit includes two transformer windings instead of the single winding shown in Fig. 24. The voltage waves in the grid circuit of tube 5 are shown in Fig. 36. We see that T5S-1 is the secondary voltage of an ordinary transformer, connected so its voltage forces the tube 5 grid negative while the anode of tube 5 is positive; in this way T5S-1 produces a "hold-off" voltage which prevents tube 5 from firing.

Control by a Peaking Transformer

The other transformer (T2S-1 in Fig. 35) is seen to produce a narrow voltage peak in Fig. 36. This peak is high enough to force the tube 5 grid positive for just a small part of the half cycle; this brief voltage peak fires tube 5. If we can change the position of this peak, we also change the point in the half cycle where tube 5 fires. By phase-shifting the voltage applied to this peaking transformer (T2), we can gradually vary the average voltage which ignitrons 1 and 2 supply to the welder.

Transformer T2 is specially designed with very little iron in its core, so that the iron is saturated during

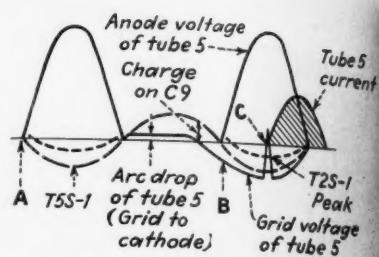


FIG. 37

most of each half cycle. When the transformer's magnetizing current reverses, there is a sudden short-time reversal of flux in the iron, producing voltage in the form of a narrow peak in each of the two secondary windings. The position of this peak is definitely fixed with respect to the a.c. voltage wave applied to the primary winding. Therefore, to move this peak and thereby change the firing point of tubes 5 and 6, we must change or shift the phase of the a.c. voltage supplied to primary (T2P).

The circuit for shifting the phase of T2P appears at the top of Fig. 35; it is similar to Fig. 25 except that a fixed capacitor (C13) replaces a fixed resistor, while a variable resistor (R30) is used instead of a variable inductance. When R30 is short circuited, the voltage peak of T2S occurs quite early in each half cycle, and fires tube 5 at A and B as shown in Fig. 36; the resulting flow of current to the welder is nearly a complete sine wave.

When part of R30 resistance is inserted, the T2S-1 voltage peak occurs later in the half cycle, as shown in Fig. 37; welder current flows for a smaller portion of the half cycle, producing partial heat at the weld. Fig. 37 also shows the purpose of capacitor C9 (shown with tube 5 in Fig. 35). To prevent tube 5 from firing accidentally at A where the grid voltage is zero, C9 is charged by grid current while T5S-1 is positive; this C9 charge drives the tube 5 grid more negative, at B, and helps prevent tube 5 from firing until C.

With all of R30 resistance inserted, Fig. 38 shows that the voltage peaks of T2S are delayed so that tubes 5 and 6 fire the ignitrons very late in each half cycle; the resulting current flow produces low heat at the welder.

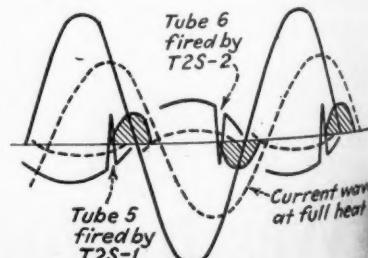


FIG. 38

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1. Selection of correct types of electrical equipment for various classes of postwar homes.
2. Location and arrangement of fixed equipment, for conserving space and attaining maximum efficiency in arrangement of kitchen and laundry work cycles.

3. Accurate dimensions and clearances of equipment to insure proper installation and efficient operation.

4. Access for servicing of equipment—so necessary for periodic inspection and repair.

5. Location of lighting outlets and controls, for greater enjoyment, comfort, and safety in the home.

6. Utility service connections—including location and size of electric wiring, water supply, and drainage lines.

If you have any problems relating to the selection, installation, and use of home electrical equipment, write: Better Homes Dept., Westinghouse Electric & Mfg. Company, Pittsburgh 30, Pa.

Tune in John Charles Thomas,
NBC, Sundays, 2:30 p.m., E.W.T.
and

"Top of the Evening"
Monday—Wednesday—Friday
Blue Network, 10:15 p.m., E.W.T.



WEBSTER ELECTRIC Teletalk... *Modern* WINGS FOR FIGHTING WORDS

Responsibility for speeding the sinews of war . . . in giant plants . . . block-long office buildings . . . shipyards . . . supply depots . . . warehouses and flying fields . . . has proven that man-hours are far too precious to waste.

Electrical contractors' salesmen can easily show that Teletalk Amplified Intercommunication Systems effectively plug the man-hour leak. Demonstrating how Teletalk's instant, personal and private communication releases messenger for productive work . . . saves precious time, steps and energy . . . quickly and easily builds profits for you.

In government offices and war factories throughout the nation, Teletalk puts ideas to work *at once*, reduces errors, increases inter-department cooperation,

permits conferences without any of the participants leaving his desk.

Teletalk systems are easy to install, economical to operate, and may be obtained to fit the requirements of any organization, whether large or small.

It will be to your advantage to investigate the easy-selling features of Teletalk. You will find it profitable.

WEBSTER ELECTRIC COMPANY, Racine, Wisconsin,
U. S. A., Established 1909. Export Dept.: 13 E. 40th St., New
York (16). N. Y. Cable Address: "ARLAB" New York City

Let's All Back the Attack
Buy Extra War Bonds



Licensed under U. S. Patents of Western Electric Company,
Incorporated, and American Telephone and Telegraph Company

WEBSTER  **ELECTRIC**
"Where Quality is a Responsibility and Fair Dealing an Obligation"

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Electrical

Electronic Motor Drive of Aluminum Miller

[FROM PAGE 55]

(or reels it back in) as the carriage moves back and forth. Thus the oil is pumped from the reservoir onto the carriage, through the motors, onto the cutters, filtered and piped back to the reservoir for recirculation.

Trolley duct is used for getting power aboard the travelling carriage. Three runs of Bulldog three-conductor bus duct are used—one carrying 440 volt, 3 phase, 180 cycle for the vertical high speed cutting motors; and two runs carrying 208 volt, 3 phase, 60 cycle for the two 30 hp. horizontal cutters. Single phase 208 volts is taken from one of the connection boxes, to supply the electronic motor drive of the carriage. Circuits are brought over from the switchboard in two runs of conduit terminating in a pull-box. The pull-box is mounted directly on the ends of the bus duct and short leads connect the cable conductors to the bus conductors.

A riser on the front end of the carriage supports two 3-phase collectors for the front horizontal 30 hp. cutting motor (one collector for each 15 hp. winding.) Three-conductor cables drop from each collector to a junction box mounted atop the carriage. Conduit carries the cables on to the circuit breakers (mounted on the carriage side) and carries the motor leads back to the same junction box. Extra-flexible rubber covered conduit then carries the motor leads into the motor.

An identical arrangement is used on the back-end of the carriage except that three collectors are required, two-208 volt, 60 cycle cables for the rear horizontal cutting motor, and one collector from the middle duct supplying 440 volt, 180 cycle power for the two 15 hp. vertical cutting motors.

For complete protection of the entire system, all magnetic control coils are in series so that when one is locked-out by a thermal element, all drop out. Further, thermal contacts in all motors are in series. Thus, in the event any cutting motor should overheat, the carriage motor and all others will drop out. The pump motor is also tied into this same control system so that all operation is locked out if the pump motor becomes inoperative.

Phil Caminiti, plant electrical engineer for Brewster, wrestled control circuits along with G. E. engineers until the present scheme emerged which has since proven very satisfactory.

PERMAFLECTOR INDUSTRIAL

DUALIGHTS

DOUBLE THE LIGHT FROM PRESENT OUTLETS



A Perfect Blend of Light

They are doing yeoman service in war plants where "good seeing" is vital; are available on priority only — normal delivery. For general plant illumination, for localized lighting of production lines, assembly benches, inspection tables. They provide light APPROXIMATING THE IDEAL in maximum QUANTITY and optimum QUALITY — give a DAYLIGHT EFFECT.

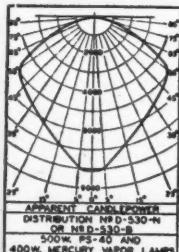
Permaflector DUALIGHTS can be quickly, easily, inexpensively installed—supply over twice as much light without increasing the number of outlets. Each twin-hanger unit is tapped for $\frac{1}{4}$ " conduit stem . . . is equipped with removable plate to simplify wiring . . . with Mogul sockets, safety holders, retaining rings, and appropriate Permaflectors for high or low bay installation.

*No. D-530-N: for Broad Distribution, with No. E-530-GA Permaflectors for 500-watt PS-40 and 400-watt T-16 Mercury Lamps.

*No. D-505-N: Semi-concentrated distribution, with No. I-505-GO Permaflectors for 500-watt PS-40 and 400-watt T-16 Mercury Lamps.

*No. D-005-N: Semi-concentrated, with Permaflector No. I-1005-GO and No. I-505-GO for 1000 or 750-watt PS-52 and 400-watt T-16 Mercury Lamps.**

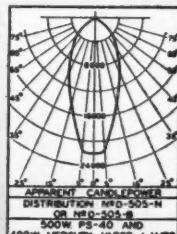
*Also available without retaining ring and strap supports, and at a lower cost as D-530-B, D-505-B and D-005-B.



PERMAFLECTORS — "shaped mirrors" of silvered glass provide engineered light control for Broad, Medium, or Concentrated Light Distribution.

**400-watt T-16 Mercury Lamp produces 40 lumens per watt — or slightly more light than the 750-watt PS-52 Incandescent — (Light is blue-green in color.)

Sold thru Electrical Wholesalers



PITTSBURGH REFLECTOR CO.

For Over A Third of A Century — ILLUMINATING ENGINEERS—DESIGNERS AND MANUFACTURERS OF LIGHTING EQUIPMENT—FOR EVERY COMMERCIAL AND INDUSTRIAL LIGHTING SERVICE

OLIVER BUILDING

PITTSBURGH, PA.

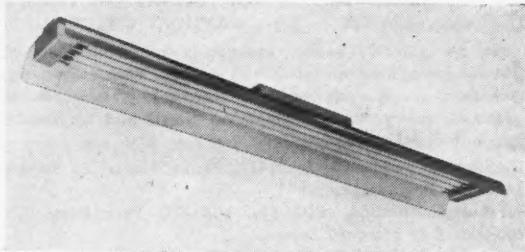
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| ★ WAR BULLETIN Although practically our entire facilities are devoted to producing special, confidential lighting equipment on prime contract for the Armed Forces, we are supplying our industrial customers on priority and our commercial customers with replacements, when possible, from stock. Startling new developments by our Engineering Department, soon to be announced, promise a better future for the commercial lighting field. | | SEE YOUR DISTRIBUTOR OR WRITE FOR COMPLETE DATA ON DUALIGHTS |
| ★ ★ ★ ★ ★ | | |

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

EQUIPMENT NEWS

Fluorescent Lighting

A new cold cathode fluorescent industrial lighting unit, known as Kold-Volt, has been announced. The lamps used are similar to the conventional "F" type fluorescent lamps, except that they are 7-ft. 9-in. long, 1-in. in diameter and employ a different type of cathode at the tube ends. Some of the features claimed are—starting instantaneous; operates at lower room temperatures; operates on regular 110-125 volts, 60 cycle a.c.; 8-foot length. It uses four "Colovolt" cold cathode low voltage fluorescent tubes. May be surface or suspension mounted, individually or in continuous rows. Mounting brackets and knock-outs are provided. The reflector is non-metal "Lumenite", which is moisture and high-heat resistant, non-corrosive, non-scaling. A special disconnect switch automatically cuts off current so that lamp replacement is always made with the power disconnected. Mitchell Manufacturing Co., 2525 North Clybourn Ave., Chicago 14, Ill.



MITCHELL KOLD-VOLT UNIT

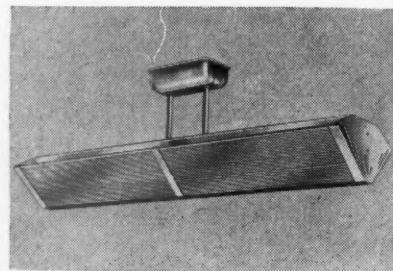
High Bay Reflectors



GUTH REFLECTOR

and are electrolytically brightened and permanently sealed by the Alzak process. Sizes for 300 to 1500 watt incandescent lamps and for 400 watt mercury vapor lamps are available. The Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.

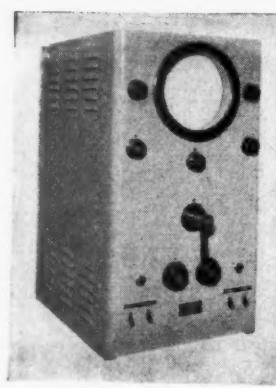
Fluorescent Fixture



SYLVANIA FLUORESCENT UNIT

A new all-purpose fluorescent fixture has been announced. It consists of a basic chassis with accessories that adapt it to various structural conditions and is for use in drafting rooms, offices, schools, hospitals, laboratories or commercial institutions. The ballasts are enclosed and knockouts are conveniently located for service entrance and pendant mounting. It is available in either the unshielded or shielded unit and uses four 40-watt fluorescent lamps. Operating voltages are 110-220 volts, 60 cycle a.c. Also obtainable in 50 cycle. Both models are equipped with two dual-lamp 40 watt high power factor auxiliaries. Sylvania Electric Products, Inc., 60 Boston Street, Salem, Mass.

Electronic Winding-Insulation Tester



G-E TESTER

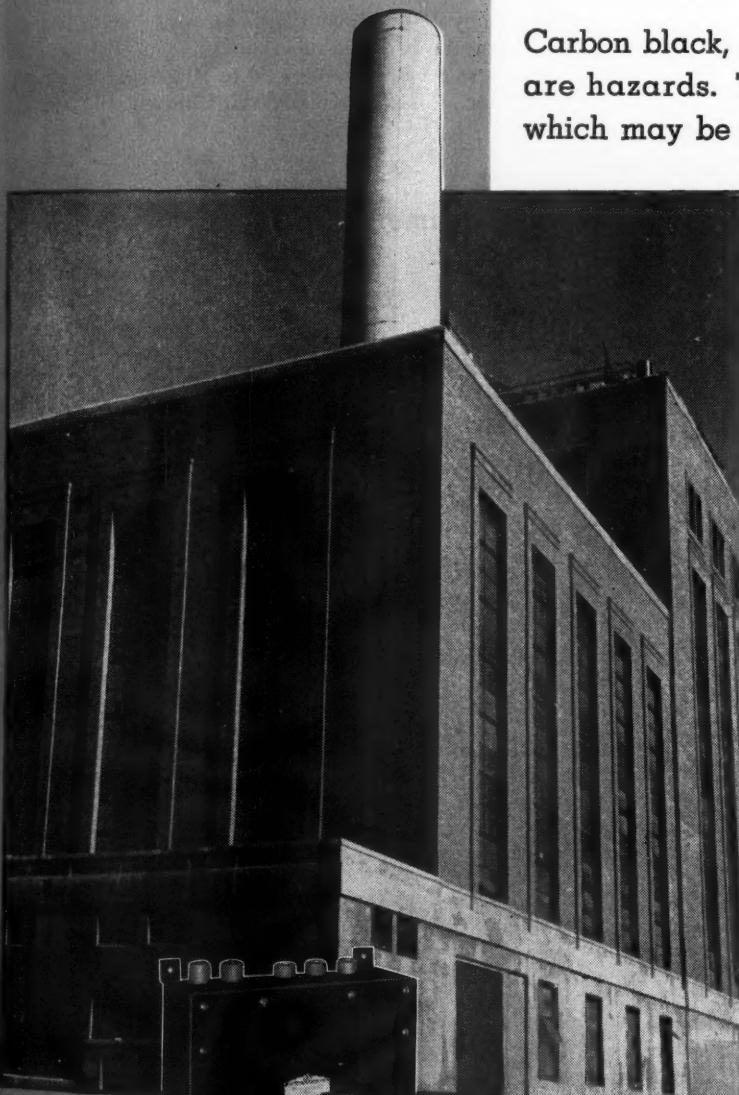
A new electronic winding-insulation tester for production-line testing of faulty insulation and winding symmetries in motors, generators, coils, and transformers has been announced. The instrument simultaneously tests turn-to-turn, coil-to-coil, and coil-to-ground insulation. It simulates such procedures as resistance, impedance-balance, turn-balance and high potential tests with one voltage application. The new instrument is particularly de-

sirable for testing the completed windings of three-phase, low-voltage rotating machines, although it is capable of testing the windings of single-phase, two-phase and d.c. motors and transformers whose insulation is not designed to withstand more than 10 kv. The tester consists of a repeating-type, surge-voltage generator, a cathode-ray oscilloscope, and synchronously driven switching equipment, all enclosed in one cabinet designed for bench mounting. General Electric Company, Schenectady, N.Y.

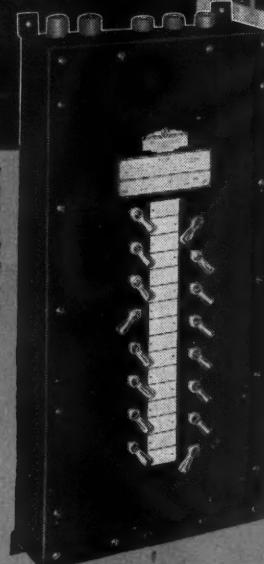
left—for
the man-
ELECTRICAL
to you.

Designed for SAFETY

in dust-laden atmospheres



This Power Plant of a large New England utility company (not identified for obvious reasons) is equipped with Frank Adam Dust-tight Circuit Breaker Panelboards in all hazardous locations.



At left: Lighting Standard type Frank Adam Dust-tight Panelboard and Cabinet for wall or exposed column mounting. (12" or 15" wide, as required.)

Carbon black, coal dust, coke dust and grain dust are hazards. To guard against dust explosions which may be set off by exposed arcs,



DUST-TIGHT Light and Power PANELBOARDS

were expressly designed. They are proving vital protection in shell-loading plants, coal mines, coal processing plants, grain mills and other places where dust is dangerous. They are approved by Underwriters' Laboratories, Inc., for "Class II, Groups F and G, Hazardous Locations."

Instead of the usual steel front with door, these panelboards have a solid steel front plate, gasketed all 'round and secured with screws to the extra wide box flange. They are further rendered dust-tight with welded hubs for conduit outlets, welded box-corners, and handle bushings riveted directly to the steel cover plate. External mounting brackets are provided to maintain the dust-tight construction.

The circuits are externally operable by a mechanism of new design. The handles operate through dust-tight bushings, and engage the regular handles of the circuit breakers inside the cabinet. ON and OFF positions are indicated on the front of the cabinet.

The Frank Adam Dust-tight Panelboard may be had in standard type or in narrow column type. It is of the circuit breaker type, with either Type AC or Dublbrak circuit breakers (or other types of lighting branch-circuit circuit breakers) . . . Capacities: Lighting Panels—50 amperes or less, for 3 wire, single phase, or 4 wire, 3 phase mains, with lugs only or main breaker. Available with 4 to 42 circuits. Power Panels—50 to 600 amperes, 250 volts AC or DC, and 600 volts AC . . . Frank Adam Electric Company, Box 357, St. Louis, Mo.



FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO. U.S.A.

Pilot Light

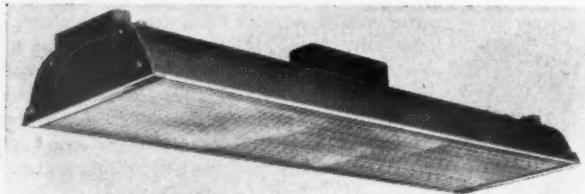


KIRKLAND PILOT LIGHT

A new pilot light, called the S11 unit, for either panel or switchplate mounting is available. It is for use with the standard S11 lamp bulb, 10 watt, available in all colors. The bulb is so recessed into the unit from the front of the panel that the tip of the lamp exposed assumes the appearance of a lens. It is claimed that this unit provides such exterior ventilation to the lamp bulb that a much greater lamp-life is to be expected. For use on panels, (single-hole mounting); it can be mounted on a single-gang switchplate to become a marker-light; exit-light; over-door light, etc. The H. R. Kirkland Company, Morristown, N. J.

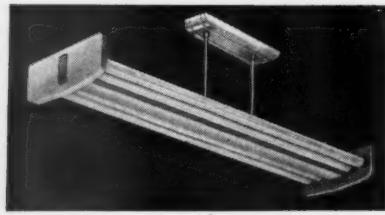
Fluorescent Fixture

This improved industrial fluorescent fixture features complete enclosure of the lamps with ribbed glass bottom and end shields, keeping out dust and cutting down maintenance trouble and expense. Location of ballast box on top of the fixture allows the ballast to run 30 percent cooler, improving operation and tube life. The fixture is made in two, three and four tube sizes for 48-in. tubes. It is the instantaneous starting type. It is available for all types of hanging arrangements, including individual, or end to end mounting. R. & W. Wiley, Inc., Dearborn & Bridge Streets, Buffalo 7, N. Y.



R & W FLUORESCENT FIXTURE

Fluorescent Fixture



MITCHELL FLUORESCENT UNIT

four 40-watt lamps. It is available for suspension mounting, surface mounting, individually or in continuous rows. Metal tracks are fastened to the ceiling with toggle bolts and furnished as standard equipment with each unit. Fixture slides into place on tracks. All-metal wireway channel and end pieces, finished in white enamel. Operating voltage 110-125 volts, 60 cycle, a.c. Higher voltages are available. Length is 49-in., width 12 $\frac{1}{4}$ -in., height 5 $\frac{1}{2}$ -in. Mitchell Manufacturing Co., 2525 Clybourn Ave., Chicago 14, Ill.

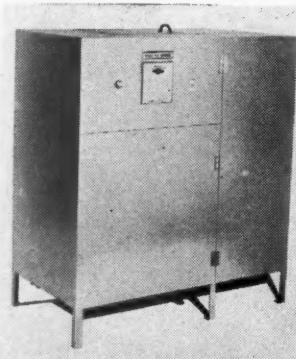
Relays for Electronic Circuits



G-M RELAY

Type 27 relay is designed for electronic circuits which require small multipole relays. The small size and rugged construction makes it suitable for many uses on aircraft and mobile equipment where vibration is encountered. General specifications of the Type 27 sensitive relays are: Size of one, two and three pole relays approximately 1 $\frac{5}{8}$ -in. by 1 $\frac{1}{8}$ -in. by 2-in. high; Five pole relays approximately 2-in. by 2 $\frac{1}{2}$ -in. by 2 $\frac{1}{8}$ -in. high; Contact capacity up to 10 amperes, depending on available power and on coil and circuit characteristics; contact pressure 30 to 50 grams. G-M Laboratories, Inc., 4314 N. Knox Ave., Chicago, Ill.

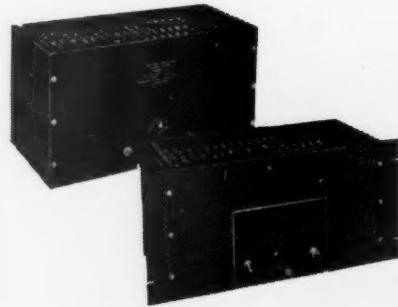
Oil Reclaimer



YOUNGSTOWN OIL RECLAIMER

A new line of YM "Robot" oil refiners, designed to clean lubricating oil with continuous and automatic operation, has been announced. It is capable of removing fuel dilution, acids, solid and colloidal carbon, dirt and similar matter. Also it can restore oil emulsified by water. A single machine can be installed to serve an entire power plant, whether large or small. Ability to restore transformer oils to 30,000 volt dielectric strength is also claimed for this machine. The Youngstown Miller Company, Sandusky, Ohio.

Power Supply Units

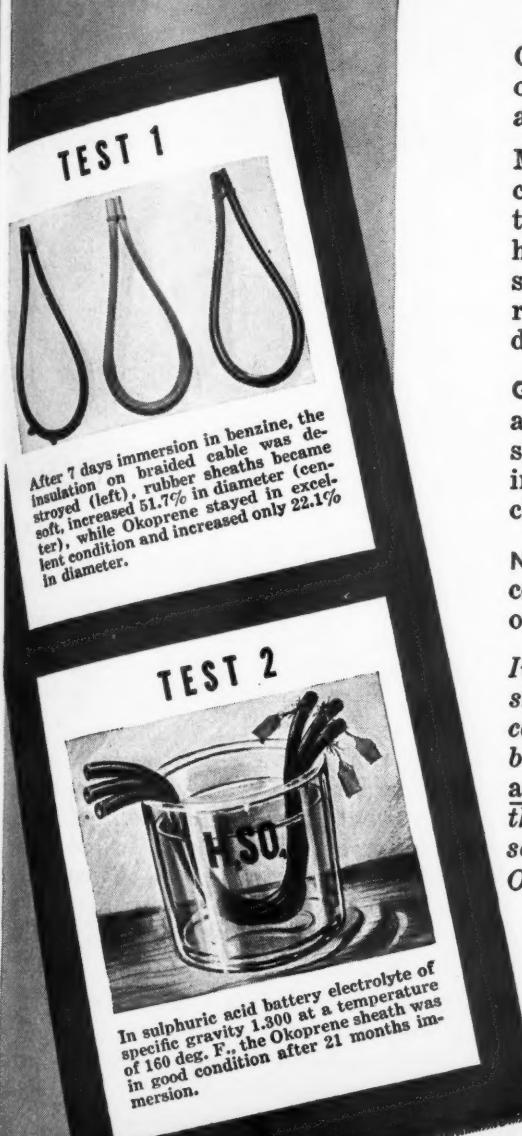


CML POWER SUPPLY UNIT

Two new voltage regulated power supply units are available. Model 1100 is a table model for use in the laboratory and Model 1110 is designed for rack mounting. Both units use the familiar series regulator circuit. A high gain two-stage control circuit is used to obtain low noise level and better regulation. The high voltage output can be shifted through a range of 225 to 325 volts by means of the potentiometer control on the front panel. The maximum current drain is 200 milliamperes from 225 to 300 volts and 180 milliamperes from 300 to 325 volts. The change in voltage output from no load to full load is less than one volt. The primary of the power transformer is tapped for use at 105 volts, 115 volts and 125 volts on a 50-60 cycle source. An unregulated heater supply winding of 6.3 volts at 5 amperes is furnished. Communication Measurements Laboratory, 116 Greenwich Street, New York, N. Y.

OKOLITE-OKOPRENE CABLES

HAVE HIGH RESISTANCE TO OIL, ACIDS AND CORROSIVES



After 7 days immersion in benzene, the insulation on braided cables was destroyed (left), rubber sheaths became soft, increased 51.7% in diameter (center), while Okoprene stayed in excellent condition and increased only 22.1% in diameter.

In sulphuric acid battery electrolyte of specific gravity 1.300 at a temperature of 160 deg. F., the Okoprene sheath was in good condition after 21 months immersion.

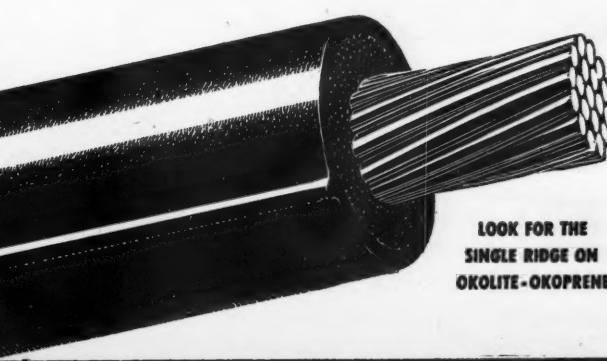
Okolite-Okoprene cables are designed to resist oil, acids and other corrosive chemicals. The Okoprene sheath also provides added electrical protection.

Moisture-resistant, tough and long-lived, Okolite-Okoprene cables require no additional covering. They are self-contained. Yet with all their advantages they cost no more than high grade braided cables. Millions of feet are giving highly satisfactory service in refineries, chemical plants, mines, railroads and other electrical applications where other cables do not last.

GREATER RESISTANCE TO OIL — When exposed to the solvent action of commonly prevalent petroleum products, Okoprene sheaths protect the wire insulation from swelling and softening. Unlike rubber, Okoprene sheaths retain their full mechanical strength after such exposure.

NOT ATTACKED BY CORROSIVE CHEMICALS — The Okoprene covering has excellent resistance to most acids, alkalies and other corrosive chemicals.

Insulated with Okolite oil-base insulation and protected by a sheath of Okoprene, moisture-resisting Okolite-Okoprene cables (U. S. Patent 2,312,058) may be installed in ducts, buried directly in the earth or exposed to the elements without additional protection. Simple to handle, splice and terminate, they are available in all standard sizes and many colors for service up to 5000 volts. For further details, send for Bulletin OK-2009C. The Okonite Company, Passaic, New Jersey.



LOOK FOR THE
SINGLE RIDGE ON
OKOLITE-OKOPRENE

OKONITE

INSULATED WIRES & CABLES

"To Prevent Needless Welder Shutdowns at Globe Shipbuilding Company We Installed BUSS Fuses,"

Says CONTRACTOR, MR. FRANK MAHAN OF BENSON ELECTRIC COMPANY, SUPERIOR, WISCONSIN



Why BUSS Fuses Don't Blow Needlessly



10 FEATURES

in the design of the FUSE-CASE help make it possible...



plus The SUPER-LAG development in the FUSE-LINK completes the job.



"At the Benson Electric Company," adds Mr. Mahan, who is manager and chief electrical engineer, "we have standardized on BUSS Super-Lag fuses for the past 7½ years, using them exclusively on all wiring and motor installation jobs.

"We have found that BUSS Super-Lag links and the design of BUSS fuse cases can be depended upon to prevent needless shutdowns of heavy starting equipment such as welders and motors. It is doubly important in shipyards like the Globe Shipbuilding Company, that are rushing material for war, that outages be held to an absolute minimum.

"This installation includes 10—400 ampere feeder circuit switches. Off each is run 24—60 ampere circuit switches serving electric welders.

"From our past experience we are sure that the installing of BUSS Super-Lag fuses at Globe Shipbuilding Company will eliminate many needless production losses."

BUSS Super-Lag



You, too, can profit by standardizing on BUSS fuses

Mr. Mahan's experience that led him to specify BUSS fuses at Globe Shipbuilding Company is a typical reaction of men who have tried these fuses. It is proof that shutdowns caused by needless blows can be prevented—and adequate protection can be provided in the same protective device.

As for BUSS Super-Lag fuses—the experience of thousands of plants throughout all industry has proven time and again that by using them you can obtain trouble-free protection at a lower overall cost than with any other renewable fuse.

They require no maintenance or periodic inspection. They don't open needlessly. If one opens, you know there is some fault that needs correction.

Here is Why BUSS Super-Lag Fuses Greatly Reduce or Entirely Prevent Needless Blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so de-

signed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus, excessive heat which causes fuses to blow when they should not is prevented.

The fuse link used is the famous "BUSS SUPER-LAG." It has lag-plates attached which give it a long time-lag so that unusually heavy starting currents or other harmless overloads will not cause the fuse to blow.

And Here is How to Solve the "Shutdown Problem" in Your Own Plant

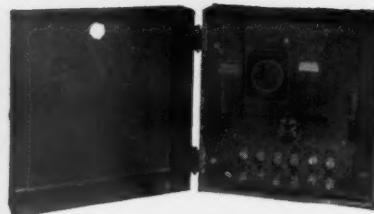
Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses give.

BUSSMANN MFG. CO., University at Jefferson, St. Louis, Missouri, Division McGraw Electric Company.

FUSES

Sold Through Wholesalers

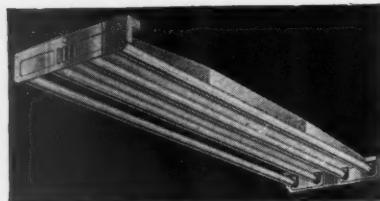
Compensator



G-E COMPENSATOR

of the weld current constant for any heat-control setting, without requiring continual manual adjustment. The compensator consists of an electronic control circuit which automatically retards or advances the firing point of the ignitron tubes used to control the welding current, thus holding the current constant regardless of line voltage changes or welding conditions. Compensator can be mounted on or near the welding machine. General Electric Company, Schenectady, N. Y.

Fluorescent Luminaire



GUTH LUMINAIRE

high intensity illumination for offices and drafting rooms in industrial plants. It has a full top housing which encloses and protects all accessories and wiring. The unit is equipped with a Masonite reflector, finished "300° White" which reflects over 75 percent of the light to the working plane. Designed for close-ceiling or suspended mountings, fixtures are installed as units, or end-to-end in continuous runs. The 48-in. long units can be had for use with either two, three or four 40 watt fluorescent lamps. It is available with conventional ballast and starter-switches or with the new Quick-liter ballast which uses no starter switches, operates at lower voltages and at low temperatures. The Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.

Balancing Compound

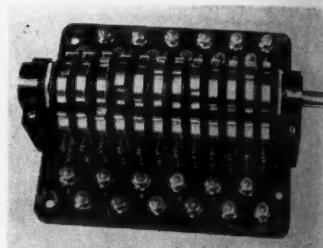
A new balancing compound R-943 is designed for the balancing of electric motor armatures. It is supplied in paste or soft putty form, so application can be made easily with the hands or with a knife. It will set in air at room temperature in about two hours to a condition such that it will not be affected by subsequent application of insulating varnishes. It does not attain its maximum hardness and mechanical strength unless it is subjected to a temperature of 135°C. It is also useful for certain types of filling operations, such as coil margins and small interstices where adhesive qualities, a low coefficient of expansion and high mechanical strength are required. Standard color is buff but also may be furnished in black. The Sterling Varnish Company, 122 Ohio River Blvd., Haysville, Pa.

Wire Solder

A new type of fluxed wire solder, known as Fluxrite, which contains flux in longitudinal grooves on the surface rather than in the conventional core, is available. It liquefies and flows onto the work before the solder melts. In addition to the prefluxing, the new solder also is said to guarantee an unbroken flow of flux. The flux supply is outside the wire and visible to the user so it can be checked quickly and readily. It comes in the same diameters as regular cored solder. It is available in two compositions designated as red stripe and green stripe. National Lead Company, 111 Broadway, New York 6, N. Y.

Rotary Limit Switch

This 12 circuit, direct connected rotary type limit switch, has 12 individual contact drums, each of which is separately adjustable by small increments. It can be used either as a continuously rotating or reversing switch and is suitable for operation in any position. The all molded construction provides easily accessible terminals, silver to silver wiping and self-cleaning double break contacts, needle bearing shaft suspension. Contacts are rated for 125 volts a.c. applications. It is recommended for service requiring a multi-contact limit switch having flexibility and ease of adjustment. Philadelphia Gear Works, Inc., Erie Ave. & G Streets, Philadelphia 34, Pa.



PHILADELPHIA ROTARY LIMIT SWITCH

Rectifiers



BX-22.3



BX-100



BX-22.4

BRADLEY RECTIFIERS

special circuits up to eight megacycles; BX-22.3 is a double bridge rectifier; BX-22.5 a single half-wave; BX-22.2 a full wave and BX-22.4 a double half-wave. Bradley Laboratories, Inc., 82 Meadow Street, New Haven 10, Conn.

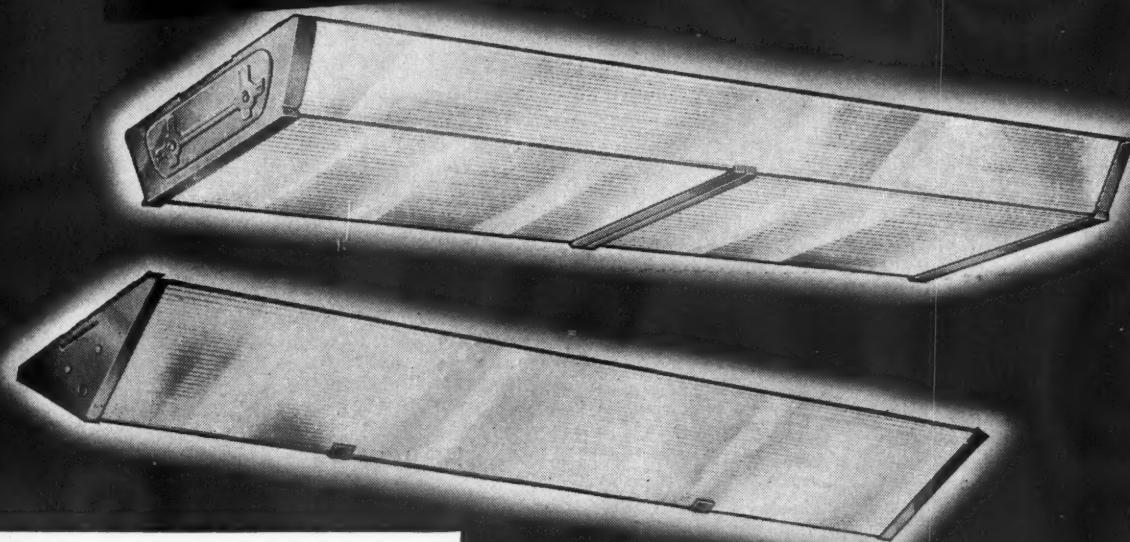
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Now Available...

New Westinghouse Commercial Luminaires



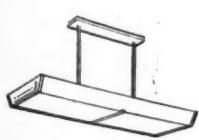
FOUR FLEXIBLE MOUNTINGS



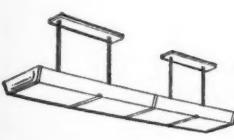
As individual units,
mounted flush with
the ceiling.



For continuous strip
applications, mount-
ed flush with the
ceiling.



As individual units,
with twin-stem
hangers.



For continuous strip
applications, with
twin-stem hangers.

The new line of Westinghouse Fluorescent Luminaires is available now for essential war applications. These handsome fixtures provide high level, glareless lighting over a wide range of intensities. Their advanced design offers many practical advantages . . . easy installation . . . simple maintenance . . . built-to-last construction.

For example, lamps can be replaced without removing glassware. Starters and ballasts are readily accessible. All glass panels can be removed for cleaning without the use of tools.

This new line of improved luminaires is available on priority order now from 117 Westinghouse Electric Supply Company offices and Independent Westinghouse Lighting Distributors. Get full details—ask for B-3332.



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Keep Up-to-Date on new developments through this **FREE SERVICE . . .**

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MAINTENANCE OF EQUIPMENT

1 A 28-page booklet of pocket size entitled "Care and Maintenance of Electrical Equipment" and containing instructions for keeping switches, panelboards and switchboards in operating condition. Square D Company

INSULATORS AND FITTINGS

2 A 12-page catalog featuring detailed specifications on Pinco pin type distribution insulators; high voltage pin types; suspension insulators; switch and bus insulators; guy strain insulators; tree insulators; draw lead-dry type equipment bushings. Porcelain Insulator Corporation.

CRANE TROUBLE SHOOTING

3 A pocket size booklet entitled "Trouble Shooting" on overhead traveling cranes, gives questions and answers to permit a closer cooperation between the crane operator and the service or maintenance department. Harnischfeger Corporation.

PANELBOARDS

4 Bulletin PB2, consisting of 12 pages, illustrates and describes tumbler switch and fuse type lighting panelboards and dead front distribution panelboards. Many photographs and

wiring diagrams are shown. Kolton Electric Manufacturing Co.

TIME SWITCHES

5 Bulletin No. TS-1 illustrates and describes this line of time switches with slow speed, self-starting, self-lubricating synchronous motor. The M. B. Austin Company

INSULATING VARNISHES

6 Bulletin 243 entitled "Sterling Speedairbonds", contains descriptions of group of air-drying, insulating varnishes, stripping compound, balancing compound, rust preventatives, commutator paints, identifiers, etc. The Sterling Varnish Company

INSTRUMENT

7 Bulletin No. 1750 describes the Jaeger speed indicator for measuring locational and surface speeds of various kinds of mechanical equipment. James G. Biddle Co.

PUMPS AND WATER SYSTEMS

8 A new consumer booklet, No. MS44, shows and describes this line of pumps and water systems for farm and home. The F. E. Myers & Bros. Company

ABRASION TESTER

9 Bulletin GEA-4166 tells how to test toughness of magnet-wire insulation with the repeated-scarp abrasion tester. General Electric Company

SIGNAL SYSTEMS

10 A new 16-page catalog entitled "Cannon Signal Systems for the Modern Hospital" illustrates and describes nurses call systems, doctor's paging systems, registers, time recorders, special switches and lights. Cannon Electric Development Company.

WIRED HOMES

11 A new 64-page illustrated book entitled "Electrical Living in 194X" explains the need for better wiring for better living in postwar homes and is for builders, contractors, architects, engineers and allied interests. Westinghouse Electric and Manufacturing Co.

BUSWAYS AND WIREWAYS

12 Bulletin 6000, consisting of 36 pages, gives description and application data on Saflex plug-in duct, Saflex feeder duct, Square-Duct and screw cover duct for electrical distribution systems. Square D Company

V-BELTS AND SHEAVES

13 Bulletin B6249, consisting of 44 pages, describes this complete line of fractional horsepower Textron V-Belts and sheaves. Allis-Chalmers Mfg. Co.

SELECTRON AND ELECTRO-MAGNETIC CHUCKS

14 A four page bulletin illustrating and describing the new DoAll electro-magnetic chuck and the Selectron, a current rectifying, demagnetizing and power varying unit. Continental Machines, Inc.

CONNECTORS

15 Catalog No. 6050, consisting of 64 pages, illustrates and describes this line of indent type electrical connectors for power plants, substations, industrial wiring, electrical equipment, grounding, welding, electronics, aircraft, ships and shipyards. Burndy Engineering Co., Inc.

GENERATOR PLANTS

16 A new 40-page engineering manual containing essential information on portable gas-electric generator

Circle numbers, sign and paste on your letterhead and mail in an envelope.

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April

(Not good after June 1)

Please send me without obligation, manufacturers' literature herein described and identified by numbers circled below.

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NAME TITLE

COMPANY

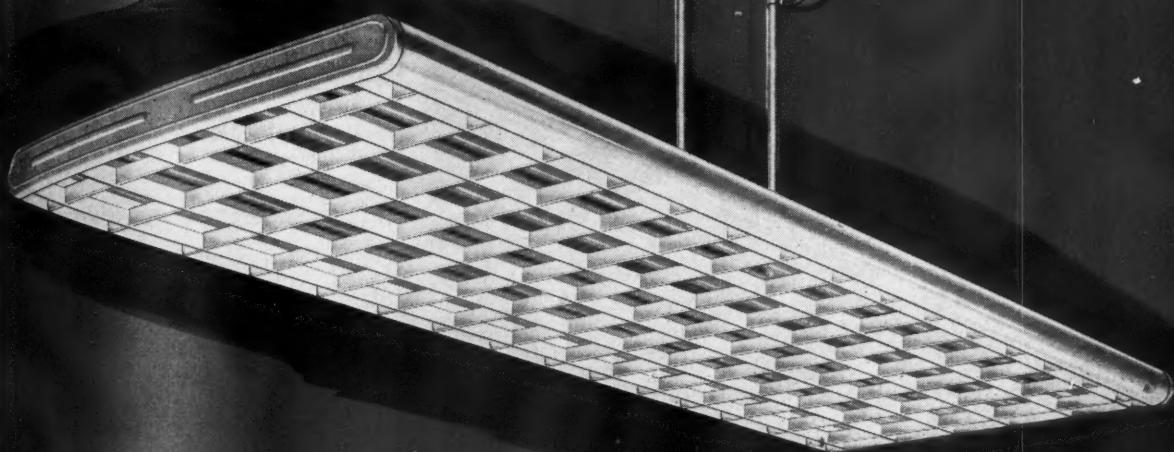
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Leader

P R E S E N T S

"THE OFFICER"



LEADER "Know How" BRINGS THE ADVANTAGES OF FUTURE LIGHTING Today

Unusual beauty incorporated through skillful engineering with the ultimate in servicing and construction features, makes the new Officer . . . Model V-440, a fascinating addition to the Leader line of fluorescent fixtures.

Diffusion of natural lamp brightness is accomplished by use of hard wood high gloss louvre without sacrificing light output. The translucent side panels of rugged molded plastic allow light transmission without glare, producing a soft illuminating effect.

Wafer thin, clean cut appearance insures trim and smart

installations, improving the lighting facilities and enhancing the beauty of the establishment.

Leader V-440 is designed for individual or continuous run mounting for either ceiling or pendant installation. Louvre, flush in unit is hinged on one side to permit servicing of unit. Tracks for surface mounting of fixture can be provided to facilitate installation. Brackets are fastened to unit and after fixture slides on the tracks, the automatic lock prevents fixture from sliding off track. No screws are necessary.

TYPICAL V-440 INSTALLATIONS



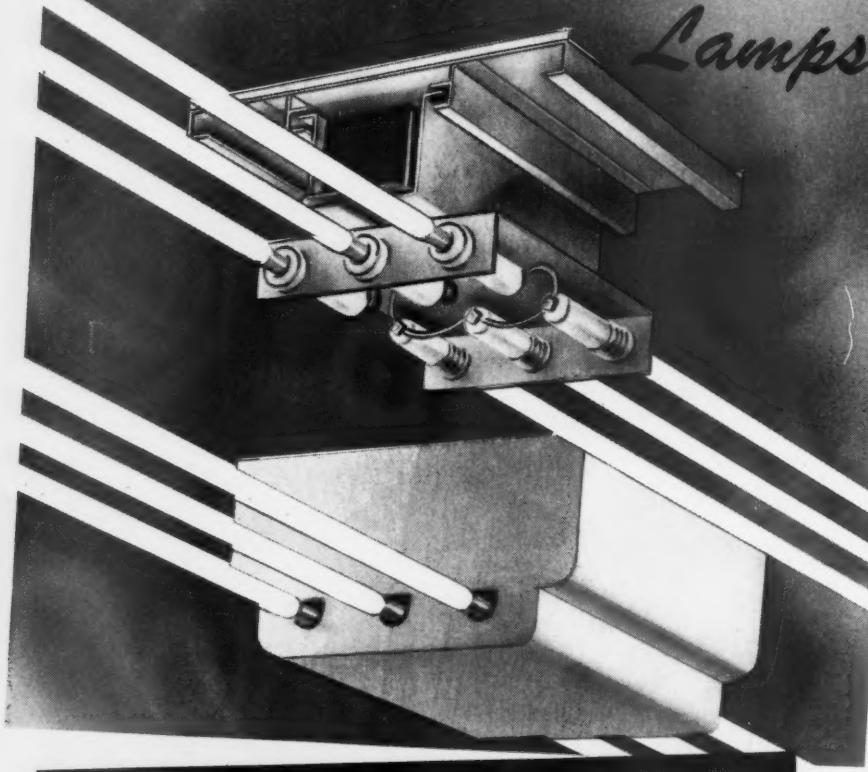
For complete information and specifications write for Bulletin V88.

LEADER ELECTRIC MANUFACTURING CORP.
6127 BROADWAY, CHICAGO 40, ILLINOIS

COLOVOLT

COLD CATHODE LOW VOLTAGE

Lamps



Check These Features

ONLY COLOVOLT OFFERS THEM TO YOU!

1. 8000-hour rated life (guaranteed for 1 year).
2. Maximum lighting efficiency, greater than any previously known cold cathode lighting.
3. Low Voltage operation eliminates high voltage wiring and bulky transformers.
4. Instantaneous starting—no starter required . . . no starting flicker.
5. Constant illumination, steady and unaffected by shock or vibration.
6. Lamps are "strob" free when used on capacitative and inductive reactor.
7. Intermediate burnouts practically eliminated.
8. Longer light source—advantageous in line lighting. Reduces glare to a minimum.
9. Low or high voltage operation!

If you would know the entire story of Cold Cathode Low Voltage Lighting—and what it means to the electrical wholesaler and the contractor, to the architect and designing engineer, as well as to the user, write today for a copy of our new booklet "Facts About Cold Cathode Low Voltage Lighting."

GENERAL LUMINESCENT CORPORATION
638 S. Federal St., Chicago 5, Ill.

plants. It is profusely illustrated with photographs, drawings, diagrams and tables. Master Vibrator Company

SHEAVE

17 Bulletin B6310 illustrates and describes the "Magic-Grip" sheave. A sequence of six photographs demonstrates the put on-take off operation for the "Magic Grip". Allis-Chalmers Manufacturing Co.

INTER-COMMUNICATION SYSTEM

18 An eight page catalog describing and illustrating the different models of intercommunication systems available in this line. Talk-A-Phone Mfg. Co.

DRY TYPE TRANSFORMERS

19 Bulletin S-202, consisting of 16 pages, describes dry type transformers for indoor or outdoor service. Built in sizes from 5 watts to 1,000 kva. with either Class A or Class B insulation. The Standard Transformer Company

FLUORESCENT ACCESSORIES

20 A new 16-page catalog on all G-E fluorescent accessories, with data on the Watch Dog starters. There are illustrations and descriptions of fluorescent lampholders, starters, ballast and other accessories. General Electric Company

FLUORESCENT LIGHTING

21 Bulletin No. 43-H features the 6000 Series fluorescent luminaires which embodies all specified design, construction and performance features of the Utilities Research Commission. Martin-Gibson Co.

DRY BATTERIES

22 A 48-page booklet entitled "The Inside Story of Dry Batteries: A Guide for Students" gives the story of the development and uses of dry batteries. National Carbon Company, Inc.

ELECTRONIC CONTROL

23 A 12-page bulletin, GEA-4126, describes the fundamentals and various applications of electronic control. It also illustrates many practical applications of electronic control. General Electric Co.

SIGNAL SYSTEM, CABLE AND WIRE DATA

24 A 24-page loose-leaf booklet on signal system, cable and wire data for engineers, estimators, wiremen and the electrical industry in general. Cannon Electric Development Company.

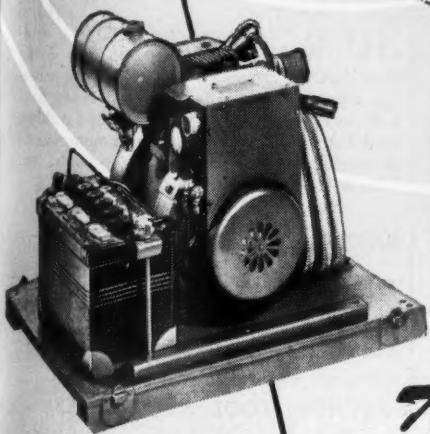
WELD INSPECTION CHART

25 A new arc welding inspection chart designed so that operators and inspectors can tell at a glance whether welds are being properly made. The Lincoln Electric Company.

BALANCING EQUIPMENT

26 Bulletin 12-V features portable balancing equipment for balancing steam turbines, electric motors, hydro generators, fans and blowers, motor

Producing for WAR COMMUNICATIONS



Mitchell Lighting Fixtures for War Industry

Mitchell Fluorescent Fixtures provide simpler, more efficient, more flexible lighting, at low cost, for work areas in war industries. "MITCHELITE" fixtures for plant lighting. MITCHELL "U.R.C." for office and drafting rooms.

The facilities of the Mitchell organization . . . the skill and energy of Mitchell men and women . . . today are devoted primarily to the production of gas-engine generator sets . . . for use in the U. S. Signal Corps and the Armed Forces of our Allies. These generator sets are used on every battle front—in scout cars, anti-aircraft artillery, and other military equipment—to provide the power necessary for vital radio communications. They can be operated by combat soldiers as easily as by highly trained radio personnel. Naturally, they must be thoroughly dependable.

MITCHELL Manufacturing Company
2525 Clybourn Avenue, Chicago 14, Illinois

MITCHELL

BACK THE ATTACK
BUY WAR BONDS

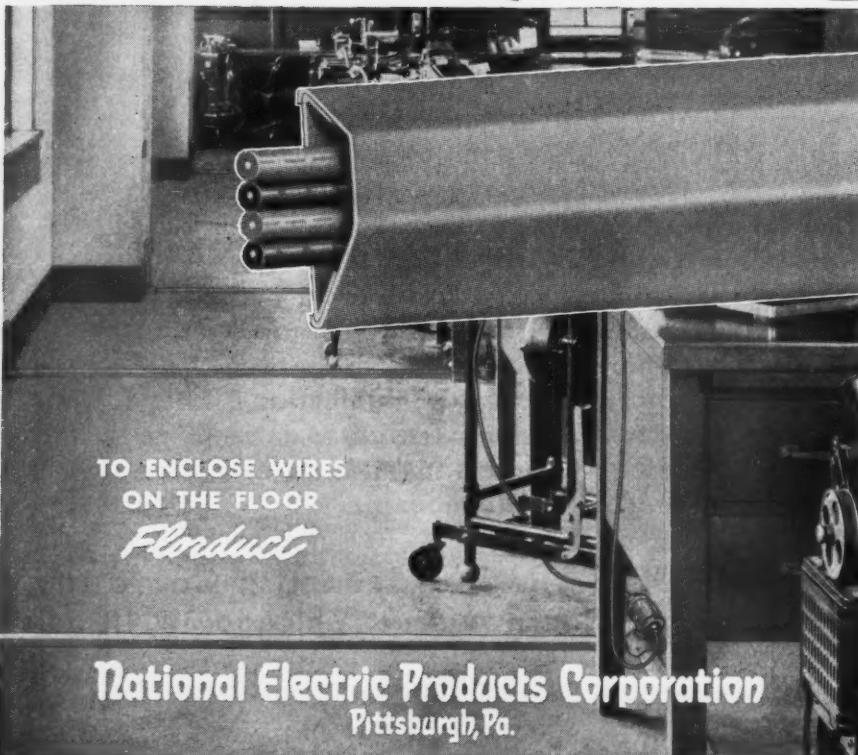
FITTINGS

for
NATIONAL ELECTRIC

Florduct



KICK-PROOF
MOP-PROOF
STRONG
SAFE
APPROVED



TO ENCLOSE WIRES
ON THE FLOOR

Florduct

National Electric Products Corporation
Pittsburgh, Pa.

generators, gears and couplings and machine parts in the shop or in the field. Vibroscope, Inc.

ELECTRIC TOOLS

27 Catalog 91, consisting of 36 pages, is also a reference manual. It illustrates and describes screwdriver bits, socket wrenches and socket shanks; auxiliary attachments and adaptors for use with pneumatic and electric screwdrivers and nut setters. Independent Pneumatic Tool Company

SUBSTATIONS

28 "Packaging Pays Off" is the title of a new bulletin, No. B6285, describing standardized load center unit substations of 100 to 2000 kva capacity for meeting the power supply needs of all types of industries. Allis-Chalmers Mfg. Co.

MOTORS AND CONTROL

29 Bulletin GEA-4139 illustrates and describes low-speed synchronous motors and control for compressor drive. It lists the important construction features and discusses the synchronization, field removal and motor protection. General Electric Company

INSULATING MATERIAL

30 A 42-page Guide book on electrical insulating materials giving descriptions on insulating papers, asbestos sleeving and tape, cotton tapes, flexible varnished tubings, varnished cambric and tape, mica, transformer compounds, storage battery seals, compounds, etc. Mitchell-Rand Insulation Co., Inc.

BATTERY CONNECTORS

31 A 24-page bulletin on this line of battery connectors for aircraft, engines and general industrial uses. Cannon Electric Development Company

MACHINE TOOL ACCESSORIES

32 A 12-page bulletin illustrating and describing a.c. magnetic chuck, triple-duty live centers, portable demagnetizer, electric tachometer, balancing ways, variable speed transmission and electric cleaners. Ideal Commutator Dresser Co.

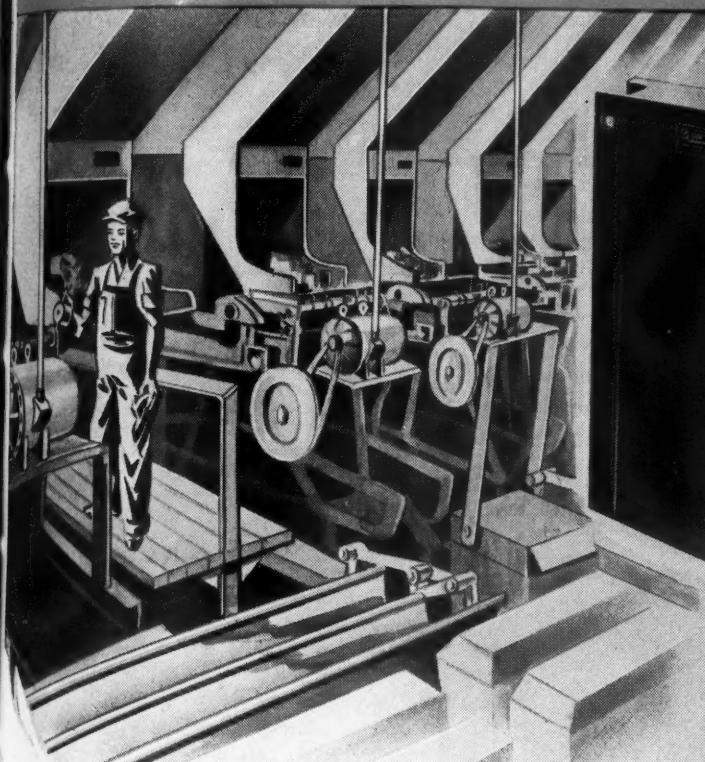
SOLDERING CHART

33 A reference chart for those interested in welding, brazing or silver soldering—a key to finding the best flux to use in connection with many metal-joining jobs. Krems and Company

POWER CENTERS

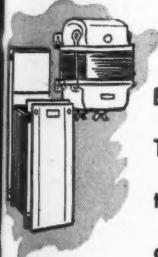
34 A 25-page booklet (B-3224) illustrates and describes power centers for quick installation in war plants, shipyards, hospitals, etc. It contains a guide to the selection and specification of indoor and outdoor transformer installations. Westinghouse Electric & Manufacturing Company

ON THE JOB...



BUT
Never
IN THE WAY

AMERTRAN DRY-TYPE TRANSFORMERS



Even in crowded load centers, AmerTran Dry Type Transformers are out of the way. Light, compact and smoothly contoured, they may be tucked into pillars or mounted overhead on I beams if necessary. They are made in a wide variety of ratings, and where ambient or operating conditions require, Class B insulation may be specified.

If you are looking for more than the usual advantages*

from transformers at load centers, you have an additional reason for investigating AmerTran Dry Type Transformers. These units are used for insulating circuits, balancing loads, boosting line voltages, and in many other special applications. Complete information covering standard and special AmerTran Dry Type Transformers for indoor and outdoor location will be sent upon request.

AMERICAN TRANSFORMER COMPANY
178 Emmet Street, Newark 5, New Jersey

* Saving copper, reducing line losses, obtaining improved voltage regulation or added load flexibility.

Pioneer Manufacturers
of Transformers, Reactors
and Rectifiers for Electronics
and Power Transmission

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N.J.



LATROBE

FLOOR BOXES LATROBE MANUFACTURING CO. WIRING SPECIALTIES

PRODUCTS

QUALITY THAT LASTS



NO. 280 NOZZLE

Shown here in No. 200 cover plate, 10 Amp. 250 volt Receptacle in Brass Housing, mounted on $\frac{1}{2}$ " brass pipe extension 3" long.

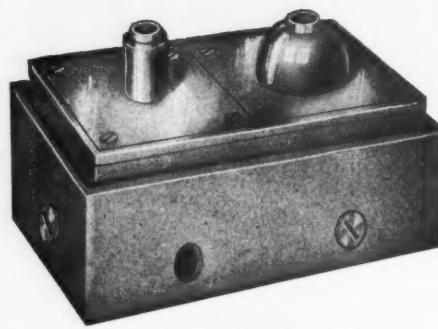


NO. 100 FLOOR BOX

with No. 206 Nozzle
Fine parts, least amount of labor to install; greater wire space inside the box body.



"BULL DOG"
INSULATOR SUPPORTS
Malleable iron of high tensile strength for fastening porcelain and glass insulators to exposed steel framework.



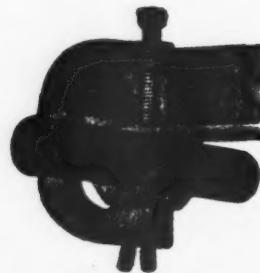
NO. 252 FLOOR BOX

Height to top of cover plate 3 $\frac{1}{2}$ in. Box bodies 3" high. Can be quickly installed.



BX CABLE STAPLES

A small item with a big reputation. Packed in cartons, kegs and barrels.



BULL DOG PIPE OR CONDUIT HANGER

A sturdy sure-grip hanger of high quality that does a thorough job economically.

Write for Catalog

**EASILY
INSTALLED**

**FULLMAN
MANUFACTURING CO.
LATROBE, PA.**

**ECO-
NOMICAL**

TRANSFORMERS

35 A 32-page catalog, Bulletin No. 117 on current and potential transformers. Many illustrations of the various types, together with drawings and mechanical data are shown. R. E. Uptegraff Manufacturing Co.

INSTRUMENTS

36 Nine loose-leaf bulletins, GEC-3750-3758 illustrate and describe the 2 $\frac{1}{2}$ -inch d.c. and r.f. ammeters and voltmeters of the new internal-pivot design for both aircraft and radio. General Electric Co.

TUBING

37 A new illustrated catalog describing fibronized extruded plastic tubing. Included are a number of product data sheets describing characteristics and applications of different types of tubings. Irvington Varnish & Insulator Company.

INFRA-RED

38 A new booklet entitled "Good Things Often Come in Small Packages!" It illustrates and describes many infra-red installations in industrial plants of 25 k.w.'s and less. The Fostoria Pressed Steel Corporation.

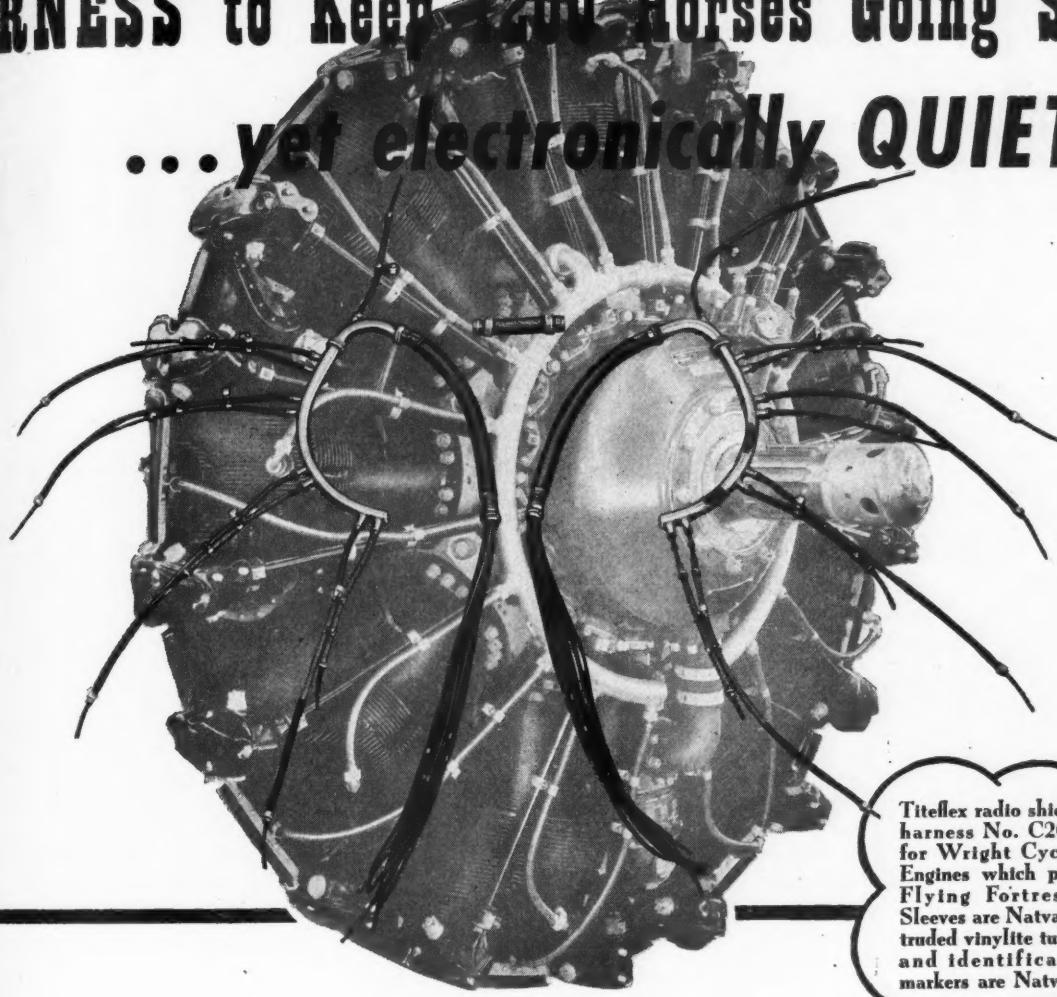
CONTROL EQUIPMENT

39 A 48-page catalog describing and illustrating enclosed safety switches, service entrance switches, multi-breaker service and load centers, motor control, open knife switches, solderless connectors and fuse holders, panelboards, and enclosed bus bar distribution systems. The Trumbull Electric Mfg. Co.



T. L. ROSENBERG, president, Northern California Chapter, NECA, with **W. J. Varley**, western field representative, NECA, at the new San Francisco office, Western Merchandise Mart.

HARNESS to Keep 1200 Horses Going Strong ... yet electronically QUIETED!



Titeflex radio shielded harness No. C26980 for Wright Cyclone Engines which power Flying Fortresses. Sleeves are Natvar extruded vinylite tubing, and identification markers are Natvar.



Titeflex harnesses physically protect high tension ignition systems from magneto to plugs and, at the same time, shield vital lines of communication from the principal source of interference—the ignition system itself.

A tremendous job, when you stop to consider that these Titeflex harnesses perform in a wind stream of over 300 mph—with or without rain and ice, but always subject to vibration. And at temperatures ranging from 50°F. below zero up to 300°F. at the spark plug end!

We are proud of the fact that Natvar extruded vinylite tubings and identification markers are contributing to this performance.

What about your requirements? Write, wire, or phone us for deliveries either from nearby wholesaler's stock, or from our own.

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished cellulose acetate
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleeving
- Varnished identification markers
- Lacquered tubings and sleeveings
- Extruded Vinylite tubing
- Extruded Vinylite identification markers

Write for bulletins

THE NATIONAL VARNISHED PRODUCTS
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CABLE ADDRESS
NATVAR: RAHWAY, N.J.

★ WOODBRIDGE NEW JERSEY

4-NVP-3



With all the performance-tested features of the Size 0 and Size 1 Colt Starters

SIZE 2 H.P. RATINGS

| Volts | Single Phase | Polypbase |
|---------|--------------|-----------|
| 110 | 3 | 7½ |
| 220 | 7½ | 15 |
| 440-600 | 10 | 25 |

Available with Local, Remote or Transfer Switch Control.

STARTERS Size 2

THE value of a motor starter to you is decided by how it measures up on three basic requirements; **performance**, **life** and **ease of maintenance**. Recognizing these requirements Colt engineers have built into this new Size 2 Starter the superior features which have won such general acceptance for the Size 0 and Size 1 Starters.

Features such as these: **Vertically Acting Magnet** that prevents accidental closing by vibration or shock; **Ball Bearing Operating Mechanism** that slides frictionlessly and assures smooth, dependable action; **Pure Silver Contacts** that minimize contact burning and replacements; **Simple, Easily-Accessible Construction** that permits replacements and maintenance work without even removing the mechanism from the case.

All of these and other equally desirable features add up to smooth, trouble-free performance, long life, and simple, easy maintenance. Before deciding upon new motor starters look over the performance-tested features of these new Colt Starters.

NOTE THESE FEATURES

- BALL BEARING SUSPENDED MAGNET** . guides contacts frictionlessly into correct alignment. Vertical magnet cannot close accidentally.
- CONTACTS EASILY REMOVED** ... any contact, stationary or movable, can be removed for inspection or replacement by merely loosening one screw.
- MAGNET COIL EASILY CHANGED** ... to change the magnet coil it is necessary to merely loosen two screws and remove two parts.
- EITHER HAND OR AUTOMATIC RESET** ... to meet requirements of the installation or the operator, by simple quarter turn of handy plungers.
- TAKES SAME OVERLOAD HEATERS** ... as Sizes 0 and 1—plus additional larger heaters. This standardization reduces to a minimum the number of spare heaters required.
- PURE SILVER CONTACT BUTTONS** ... minimize contact burning and replacements.
- EASY TO INSTALL AND MAINTAIN** ... entire unit is mounted on a steel plate. Plenty of wiring space. Pressure wire connectors.



COLT

COLT'S PATENT FIRE ARMS MFG. CO., ELECTRICAL DIVISION, HARTFORD, CONN.

BRANCH OFFICES: Boston, New York, Philadelphia, Pittsburgh, Cleveland, Chicago
PACIFIC COAST REPRESENTATIVE: The Frank H. Bran Co., Los Angeles, San Francisco

IN THE NEWS

AA-3 RATING FOR REPAIR SHOPS

Repair shops may use the AA-3 preference rating assigned them by Controlled Materials Plan Regulation 9-A to obtain fractional horsepower motors from dealers, wholesalers or motors agencies, according to the War Production Board.

The AA-3 rating of CMP regulation 9-A was assigned on November 25, 1943, to electricians, plumbers, motor rewinders, electrical contractors, carpenters, blacksmith shops and farm machinery, radio, refrigeration, boiler, automotive, upholstery and bicycle repair shops to enable them to obtain more readily parts and materials for their operation, WPB explained.

Any dealer, wholesaler, or motor agency having fractional horsepower motors for sale is required to honor the AA-3 rating from repair shops if the motors in stock are not needed to fill orders bearing better preference ratings. However, the buyer must be willing to meet the seller's regularly established prices and terms of sale or payment.

Any seller who fails or refuses to accept an order bearing a preference rating may be required, upon written request of the person placing the order, to give his reasons in writing for such failure or refusal.

Since the demand for fractional horsepower motors for combat services is unusually large, it is necessary to restrict their sale to essential purposes. For this reason, only those fractional horsepower motors needed to replace broken-down motors may be sold without a rating, and these replaced motors must be taken in exchange to be repaired where practicable and to be resold under similar conditions. Motors for any other purpose may be sold only on orders bearing a preference rating.

An old motor cannot be demanded by a dealer, wholesaler or motor agency for a new motor as part of the purchase price on an order bearing the AA-3 rating, it was pointed out.

Emphasis was placed on the repair of broken-down motors as quickly as possible because of the shortage of new motors for servicing refrigerators, oil

burners and stokers, washing machines, water systems, etc., whose operation WPB said, is important in maintaining civilian economy and morale.

Repair shops that are not equipped to rewind or repair motors may have this work done at motor repair stations in the local areas or by manufacturers who have established repair stations and replacement centers at centrally located points, or they may exchange broken-down motors for new ones at the manufacturers' stations. Some manufacturers will repair or exchange motors other than their own make at their repair and replacement centers. However, repair shop operators should ascertain from the manufacturers' local agency or factory that motors can be exchanged or repaired before they are sent to the repair station.

The motor repair situation has improved in the last few months, so all sources of repairs should be rechecked, if necessary, for possible improved service.

Every wholesaler, motor dealer or agency interested in having a small supply of fractional horsepower motors for resale to repair shops on rated orders is urged by WPB to file immediately a Form WPB-547 (formerly PD-IX) application. Although in the past it took five or six months for these orders to be filled, it is hoped, WPB said, that soon this condition will improve and deliveries will be made sooner.

ORDER L-212 AMENDED

The War Production Board has removed restrictions on the use of metals in industrial type incandescent lighting fixtures, and metal restrictions on residential types of incandescent lighting fixtures were relaxed.

These changes are made by Order L-212 as amended, which is a complete revision of the order originally issued in March, 1943. The order covers the three types of fixtures known as industrial, utility, and residential.

Industrial fixtures are designed for use in machine shops, warehouses, power plants, docks and other manufacturing, storage, or transportation areas. Utility fixtures are designed for use in offices, hospitals and stores, for stage and theatre lighting, exit signs, and similar purposes. Residential fixtures are those used for illumination in homes.

Under the terms of the order as amended, the sale of industrial and utility



"Please, Miss Martin, we have to follow the blueprints and can't go putting the light fixtures where we think they'll look cute!"

CONTROL BOARDS

"CUSTOM-MADE"
by SPECIALISTS

in SHEET METAL FABRICATION

Kirk & Blum is well known throughout the electrical industry for expert design, accurate workmanship, and perfection of detail in sheet metal equipment made to meet special requirements.

36 years of intensive experience gives us the "know how" to fabricate your Switch Gear Housings, Cubicles, Control Desks, Busway Instrument Panels, etc. *the way you want them.*

Our engineers interpret your blue prints with

absolute fidelity. And modern expanded facilities, plus skilled workmen trained in the use of specially built equipment, enable us to produce your work *faster and more economically.*

For sheet steel fabrication made the way you want it, when you want it, at lower cost—you can always rely on Kirk & Blum.

*Send your blue prints for prompt quotation to
The Kirk & Blum Manufacturing Co., 2855
Spring Grove Ave., Cincinnati, Ohio.*

ACCURATE SHEET METAL FABRICATION -- CAPACITY $\frac{3}{8}$ " AND LIGHTER



KIRK AND BLUM

AN ORGANIZATION OF

ENGINEERS AND MECHANICS

MANUFACTURING DEPARTMENT
SPECIAL SHEET METAL PRODUCTS
MACHINE BASES, PANS & GUARDS
TANKS, ELECTRICAL ENCLOSURES
CAB AND BODY STAMPINGS

FABRICATING DEPARTMENT
SHEET STEEL AND LIGHT PLATE WORK
STAINLESS AND ALUMINUM FABRICATION

PLANT EQUIPMENT DEPARTMENT
DUST AND FUME CONTROL SYSTEMS
COOLING SYSTEMS FOR GLASS PLANTS
VENTILATING AND AIR CONDITIONING
INDUSTRIAL DRYING AND BAKING OVENS

fixtures is limited to purchase orders bearing preference ratings of AA-5 or better. For both types, however, purchase orders with lower ratings assigned prior to March 15 may be filled.

For utility fixtures, restrictions on the diameters of the canopy and globe holder have been removed. Certain types of utility fixtures may be manufactured only on specific WPB authorization, for which application is filed in Washington.

Metal restrictions on residential type fixtures have been eased to the extent that 12 ounces of metal may now be used for a ceiling type fixture and an additional 8 ounces of metal may be used for the chain or stem of a suspended type fixture. The previous order prohibited use of more than 6 ounces of ferrous metal. As in the original order, there are no restrictions on sales.

Despite relaxations on the use of metal, other WPB orders restricting the use of materials in incandescent lighting fixtures and parts must be fully complied with, as for example, M-1-i (aluminum), M-9-c (copper), and M-126 (iron and steel).

L-212 as amended reflects easing of the materials situation. Relaxation of restrictions will result in the production of better fixtures, WPB said.

PROCEDURE FOR CONSTRUCTION AUTHORIZATION SIMPLIFIED

The procedure for obtaining authorization to begin construction of hotels, apartment buildings and office and loft buildings has been revised as a result of the general simplification of the procedure for acquiring authorization for all agricultural, commercial and industrial construction which became effective February 15, 1944, the War Production Board has announced.

The new procedure is quite different

from the former method where as applicant in addition to being required to justify the need for his project, had to list all materials to complete the job. Under the new procedure, an applicant still must justify the essentiality of his project and list certain scarce items of equipment and material, but is not required to enumerate specifically all construction materials needed.

Materials control is obtained under the revised procedure by the use of "Construction Limitations", a guide which is included in the instructions to Form WPB-617. It indicates in advance to the applicant the current prohibitions and restrictions on the use of critical materials. The applicant checks his own list of materials required for his project with the "Construction Limitations."



MOTOR PROBLEMS was an after session topic discussed by Everett Bacus (left) Westinghouse Electric Service Shop, St. Louis and Clarence Klauber, assistant chief electrician at Laclede Steel Co., Alton, Ill., at a recent meeting of the Industrial Division of the St. Louis Electrical Board of Trade.

AA-5 RATING FOR INDUSTRIAL EQUIPMENT

A new minimum preference rating of AA-5 or better, designed to curtail distribution, has been established for 22 classes of industrial equipment, the War Production Board has announced. Previous requirement had been A-1-c or better.

Some of the classes of industrial equipment affected by the change in rating requirements, now covered by this amendment to Limitation Order L-123, include air filters, arc welding machines, flexible metallic hose, tubing and fittings, certain types of industrial ovens and wire working machinery, none of which was previously under this order.

The amended order (L-123) no longer applies to conveying machinery and mechanical power transmission equipment, which are covered by Limitation Order L-193; portable (platform type) elevators and steel platforms, covered by

Limitation Order L-287; safety switches and knife switches, covered by Limitation Order L-315; or circuit breakers, covered by Limitation Order L-300.

Deliveries of new equipment covered by the amended order cannot be made by manufacturers, distributors, dealers or other persons except to fill orders rated AA-5 or better. The restriction also applies to deliveries from one department of an organization to another when the equipment becomes a component for incorporation into other machinery the organization may produce, or for installation and operation by such organization.

The restriction does not apply, however, when one department or branch of a company delivers equipment to another branch for eventual resale and for which a preference rating will be required. Such inter-departmental delivery would not constitute a transfer or change of ownership, but merely a physical change of position for the purpose of facilitating warehousing or delivery to eventual users.

Exceptions to the restrictions are allowed for various cases where deliveries are made in accordance with other regulations, or for certain specified transactions, such as:

Repair parts: Delivery of repair for any item (but no complete item may be considered as a repair part and delivered under this exemption, even though it could be used as a component part of another item or of machinery not covered by this order).

Specific authorizations: Deliveries specifically authorized or directed by WPB.

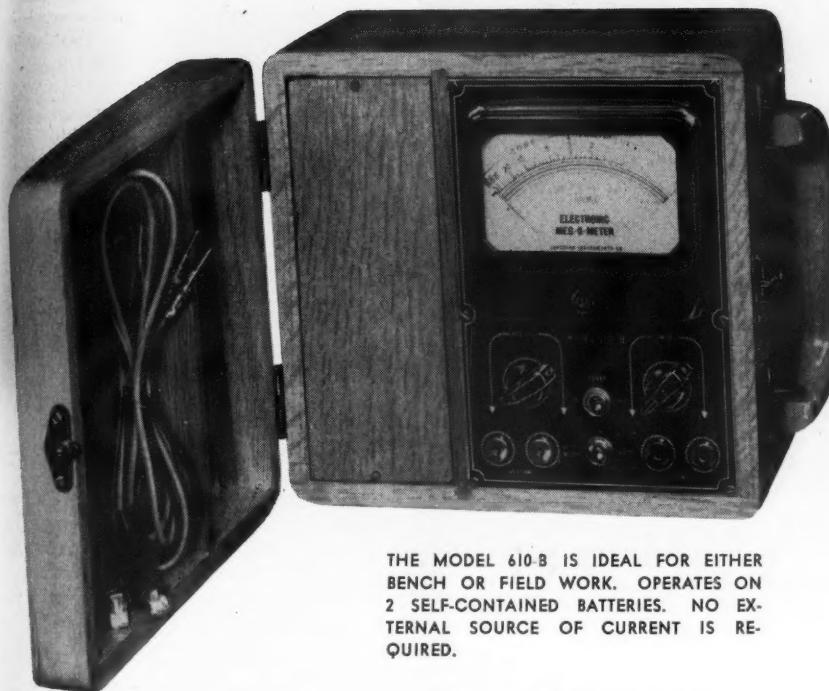
The replacement of a fractional horse-power electric motor or generator that is traded in when repair is needed: When



DIRECTORS AND OFFICERS of the reorganized Northern California Chapter, N.E.C.A., at its new headquarters in the Western Merchandise Mart, San Francisco. At the rear seated is W. J. Varley, Western field representative, N.E.C.A., T. L. Rosenberg, Oakland, president of the chapter and T. M. Robinson, Fresno. Seated front row J. D. O'Connor, Sacramento, George Abbott, San Francisco, Roy Butcher, W. T. Drury, Bakersfield, Edward Pierce, Vallejo, and Seth Cohn, San Mateo. Grover Grider, Stockton, left early, Wesley Evans, Salinas and Harry Eklund, San Rafael were absent.

The Model 610-B

MEG-O-METER



THE MODEL 610-B IS IDEAL FOR EITHER BENCH OR FIELD WORK. OPERATES ON 2 SELF-CONTAINED BATTERIES. NO EXTERNAL SOURCE OF CURRENT IS REQUIRED.

A New,
Battery-operated
INSULATION TESTER!!

Instantaneously measures the exact leakage of all insulation from zero up to

200 MEGOHMS

At a Test Potential of

500 VOLTS D.C.

Supplied by built-in battery and vibrator power supply.

3 RANGES:

0 — 20,000 OHMS.

0 — 2 MEGOHMS.

0 — 200 MEGOHMS.

ADDED FEATURE: The MODEL 610-B has been designed to function with a high degree of accuracy both as a resistance measuring instrument and as an insulation tester. In addition to the 0 to 200 Megohm Range which is used for insulation testing, two additional lower resistance ranges are provided. The two lower Resistance Ranges are 0 to 20,000 Ohms and 0 to 2 Megohms. Thus the MODEL 610-B may be used to accurately measure all resistances from 0 to 200 Megohms.

Specifications

***NO HAND CRANKING—** The 500 VOLT POTENTIAL is made instantly available by simply throwing a front panel toggle switch.

***DIRECT READING—** All calibrations printed in large easy-to-read type enabling exact determination of leakages from 0 to 200 Megohms. In addition, the Megohm scale is also sub-divided into BAD (0 to 1 Megohm) DOUBTFUL (1 to 3 Megohms) GOOD (3 to 200 Megohms) sections. The BAD Section which indicates the danger point is printed in red.

*The instrument is housed in a heavy-duty Oak portable cabinet.

*Meter movement—a 4½" 0 to 200 Microampere sensitive meter guarantees extremely accurate readings on all ranges.

Model 610-B comes housed in a beautiful, hand-rubbed Oak cabinet complete with cover, self-contained batteries, test leads and instructions. Sizes 9½" x 8½" x 6". Shipping weight, 16 pounds.

\$62 50

Important: We also make the Model 610-E Meg-O-Meter which operates on 110 volt 60 Cycle A.C. The Model 610-E is especially recommended for production testing where product must meet specified insulation requirements. Model 610-E provides exactly same services as the Model 610-B except that it operates on 110 \$52 50 Volt A.C. current instead of batteries. Price of Model 610-E complete is

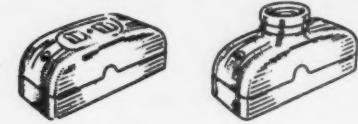
SUPERIOR INSTRUMENTS CO., Dept. E. C., 227 Fulton St., New York 7, N. Y.

YOU CAN'T BEAT Porcelain Protected Wiring

SURFOLETS...

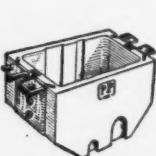
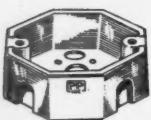


For a smarter-looking, better job of surface wiring. Save time and material in installation. One standard base under all devices.



PORCELAIN OUTLET BOXES...

For non-metallic systems. Low cost, superior safety, plus long life. Corrosion-proof, rust-proof, fire-proof, short-proof, shock-proof.



*Wire Today
for Tomorrow's Load*

- ★ LOWEST COST
- ★ GREATEST SAFETY
- ★ SIMPLEST INSTALLATION
- ★ LONGEST LIFE
- ★ UTMOST RELIABILITY

Porcelain Protected Wiring meets all requirements of directives calling for non-metallic wiring and non-metallic wiring materials.

PORCELAIN PRODUCTS, Inc.
FINDLAY, OHIO

a fractional horsepower electric motor or generator is delivered to a householder or other user solely for replacement of a used one that needs repair and the seller, in accordance with his regular business practice, takes the broken down or defective motor or generator in trade and repairs it or delivers it to another person who will repair it (whenever repair is practicable) so that it will be resold under similar conditions (or scraps it promptly when repair is impracticable).

No repairman or other person may deliver such an item unless he either complies with the foregoing conditions, or receives an AA-5 or better rating for the delivery from his customer, even though he has obtained the items under a regulation or order that assigns a rating for repair or maintenance purposes, such as the following: CMP Regulations 5, 5A, or 9A, or Orders L-79, P-126, or P-148.

This exemption permits a dealer not having repair facilities to deliver such a traded-in motor or generator, if it is repairable, to the manufacturer or some other supplier who will repair it or have it repaired within a reasonable time, and get one in exchange without an AA-5 or better rating. The manufacturer or other supplier who is asked to deliver a new item to a dealer in exchange for a used one is responsible for determining if the traded-in item is repairable.

HOUSING UTILITIES STANDARDS SIMPLIFIED

The Office of War Utilities has revised and simplified its Housing Utilities Standards to allow for greater absorption of excess utility inventory and allowing some small increase in the amount and kinds of allowable material.

The new standards, which supersede those issued August 25, 1942, remove restrictions on the types of conductor which may be used and allow the use of parkway cable. Street lights may be spaced on an average of one for each 500 feet rather than one for each 1,000 feet as provided in the earlier standards.

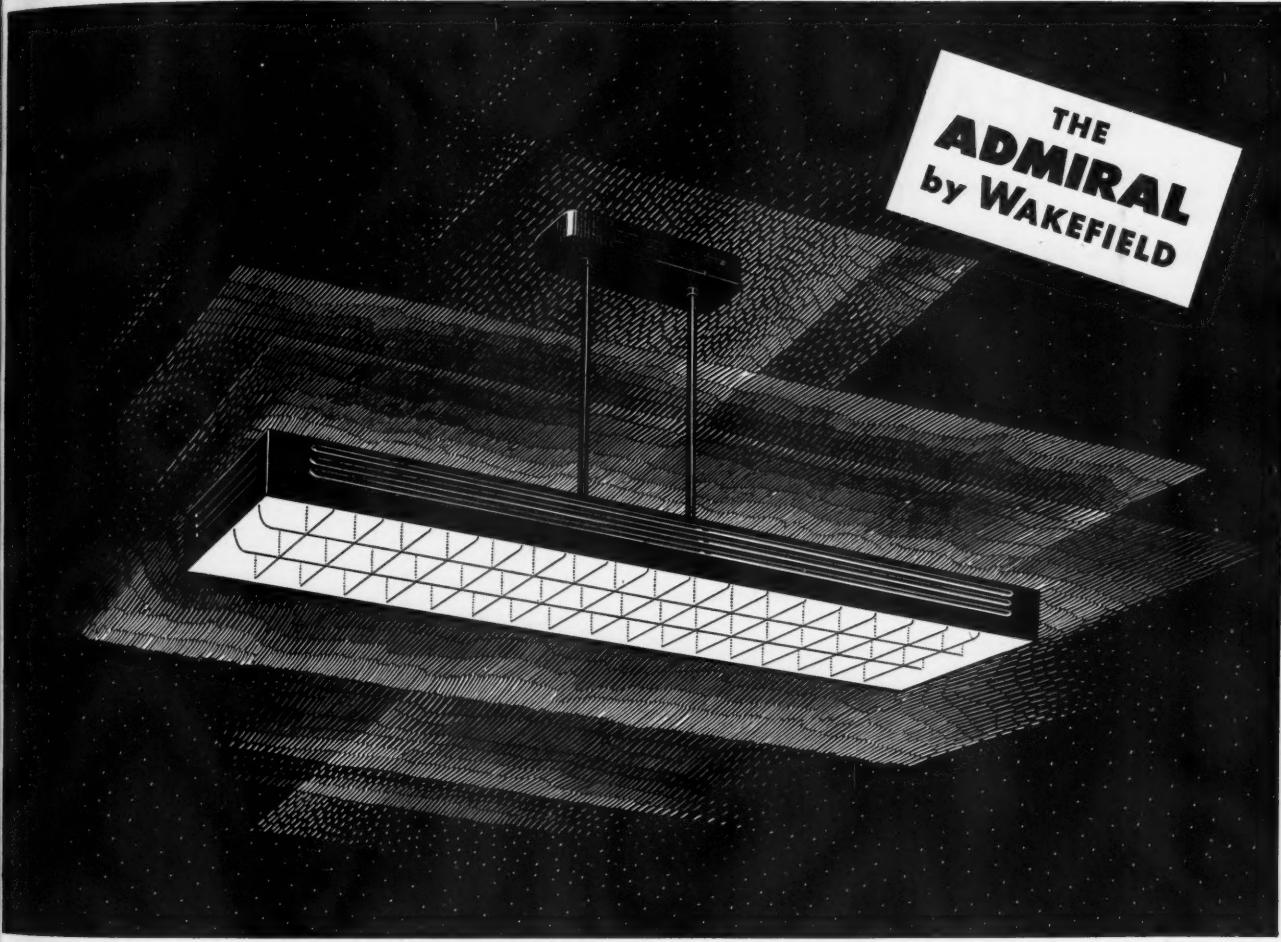
The new standards do not replace those contained in Schedule I of order U-1-f, but are applicable only to those construction or remodelling jobs for which an L-41 authorization is required.

P.A. EQUIPMENT AVAILABLE TO ADDITIONAL INDUSTRIAL PLANTS

Public address system sound equipment will be made available to a limited number of industrial plants engaged in essential war work, the War Production Board has announced.

The industrial sound systems have a wider use than merely providing music as a stimulus to workers during fatigue periods. They are also used to page personnel in a plant, to distribute "bulletin board" information to workers, and to give emergency warnings.

For lighting war plant OFFICE or DRAFTING ROOM



Effective... Efficient... Attractive!

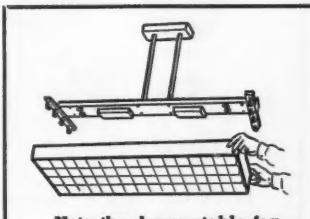
PLEASENG to look at "tops" to see by, and built for service . . . that's the ADMIRAL! It is a natural for lighting the essential office or drafting room. Tell your customers!

Made largely from wood, the ADMIRAL conserves war material and meets WPB limitations on use of metal. At the same time, it provides efficient, high intensity, diffused fluorescent light to help handle wartime paper work faster, with less eyestrain. The ADMIRAL puts 90% of its light down on desk tops or boards and al-

lows the rest to go upward to avoid ceiling contrasts. This makes it especially effective for work that involves critical seeing or for relighting older office space which has poor ceilings. Walnut finish outside, white enamel inside. Comes in 2, 3 and 4-lamp units. Write us for details that will help you serve your customers.



HELP PREVENT
INDUSTRIAL ACCI-
DENTS . . . GUARD
MOVING PARTS . . .
HAVE GOOD LIGHT
. . . BE ALERT.



Note the demountable fea-
ture of the Admiral's frame
and reflector. This makes it
easy to clean, or re-paint to
fit new office decorative
schemes.

Wakefield also offers sev-
eral other fluorescent units
for office lighting. We'll be
glad to send details on re-
quest.

THE F. W. Wakefield BRASS COMPANY
RED SPOT LIGHTING FOR WAR PRODUCTION . . . FOR PEACETIME FUTURE

VERMILION, OHIO

FAN PARTS!

* NOW IS THE TIME TO
OVERHAUL YOUR FANS

Fan Parts in Stock for

DELCO

DIEHL

EMERSON

GENERAL ELECTRIC

GRAYBAR

HUNTER

ROBBINS & MYERS

WESTINGHOUSE

* No Priorities Required *

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

200 William St.

New York 8, N. Y.

Barclay 7-6616

A Complete Line of
BAKELITE
OUTLET BOXES and COVERS

THAT MEET THE NATIONAL ELECTRICAL CODE AND APPROVED BY
FEDERAL HOUSING ADMINISTRATION

BOXES FURNISHED WITH OR WITHOUT CLAMPS



No. 3060



No. 4050



No. 5050



No. 6050



No. 7050



Nos. 3051 & 4051



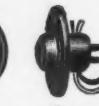
Nos. 3052 & 4052



Nos. 3053 & 4053



Nos. 4054 & 4055



Nos. 3056 & 4056

SAFE • ECONOMICAL • DURABLE • NEAT

The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one $\frac{1}{2}$ in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

UNION INSULATING COMPANY, INC.

FACTORY:

PARKERSBURG, W. VA.

SALES OFFICE:

27 PARK PLACE, N. Y. C.

An applicant seeking industrial sound equipment must file Form WPB-617, the Radio and Radar Division said. WPB will control the number of installations under Limitation Order L-41, governing construction. Production of industrial sound equipment units will be authorized only by such firms as have facilities and manpower to produce them without interfering with other war production.

COMING MEETINGS

National Industrial Service Association, Inc.—Annual Conference, Netherlands Plaza Hotel, Cincinnati, Ohio, April 12-13.

National Electrical Contractors Association—General Meeting, Jefferson Hotel, St. Louis, Mo., April 15-16.

National Electrical Wholesalers Association—Second Annual War Conference, Stevens Hotel, Chicago, Ill., April 18-21.

National Electrical Manufacturers Ass'n—Spring Meeting, Palmer House, Chicago, Ill., April 24-27.

National Fire Protection Ass'n—Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., May 8-11.

American Institute of Electrical Engineers—Summer Technical Meeting, Jefferson Hotel, St. Louis, Mo., June 26-30.

National Electrical Manufacturers Association—Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y., October 23-27.

AMENDMENT NO. 6 TO WIRE, CABLE, AND CABLE ACCESSORIES

Sales of services that contribute to the fabrication or insulation of wire, cable and cable accessories will be priced according to provisions of the regulation establishing prices for the finished wire and cable products, the Office of Price Administration announced in Amendment No. 6 to Revised Price Schedule No. 82—Wire, Cable, and Cable Accessories.



ELECTRICAL ENGINEER J. Webb, Eli Lilly Company, Indianapolis, assumed role of discussion leader at the electrical maintenance panel of the recent Indianapolis War Production Clinic. Panel was sponsored by the Electric League of Indianapolis, Inc.

Electrical Contracting, April 1944

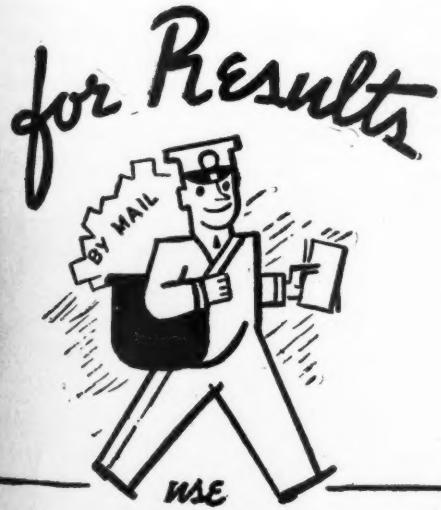
MAILING LISTS THAT WORK . . .

McGraw-Hill Industrial Mailing Lists are a direct route to today's purchase-controlling executives and technicians in practically every major industry.

These names are of particular value now when most manufacturers are experiencing constantly increasing difficulty in maintaining their own lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled changes in industrial personnel. These lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nationwide field staff, and are maintained on a twenty-four hour basis.

Investigate their tremendous possibilities in relation to your own product or service. Your specifications are our guide in recommending the particular McGraw-Hill lists that best cover your market. When planning your industrial advertising and sales promotional activities, ask for more facts or, better still, write today. No obligation, of course.



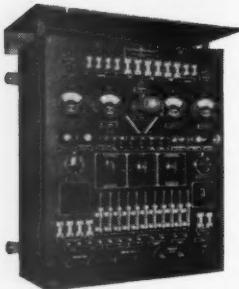
Mc GRAW-HILL
DIRECT MAIL LIST SERVICE

McGraw-Hill Publishing Co., Inc.
DIRECT MAIL DIVISION

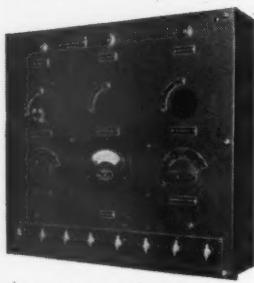
330 West 42nd Street New York, 18, N. Y.

Electrical Specialties of Every Type

Including MARINE WORK



WORK TEST PANEL—built to customers' specifications and Navy standards.



RADIO MOTOR-GENERATOR and SELECTOR CONTROL PANEL—built to customers' specifications for any number of circuits.



ALL types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army, Navy and Commercial specifications. Full engineering personnel and equipment for manufacture of special electrical items to customers' needs in addition to all standard articles. Let us quote you on your requirements. Write for illustrated catalog.

**Jacksonville Metal
Manufacturing Company
247 Riverside Avenue
Jacksonville, Florida**



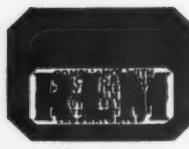
ADJUSTABLE PORCELAIN
ENAMELED FLOODLIGHT



No. 1184-M
RLM THREADED DOME REFLECTOR



LIGHTING UNITS



• The QUAD line offers you the finest in Industrial Lighting Equipment for those important victory manufacturing installations. The demands for additional lighting in plants increases daily and QUAD units—RLM and other porcelain enameled units—will fill indoor and outdoor needs perfectly.

QUADS . . . for today and for tomorrow!

QUADRANGLE MFG. COMPANY

Mfrs. of Incandescent and Fluorescent Lighting Equipment
32 SO. PEORIA ST.

CHICAGO, ILL.

This action, which became effective March 18, 1944, fixes maximum prices for fabrication services not to exceed the net price the supplier had in effect for a similar operation on October 15, 1941, or on the latest date within six months prior to that time.

Formerly there was specific control of prices for rolling and drawing copper into wire, but no specific control for fabrication services. Including the service charges in the wire and cable regulation will provide a specific pricing method where the copper wire is furnished to manufacturers for further processing for the supplier.

FLUORESCENT FIXTURE PROBLEMS REVIEWED BY WPB

The effect upon the fluorescent lighting fixture industry of possible relaxation of restrictions on the use of metal in its products was reviewed by members of the Fluorescent Lighting Fixture Industry Advisory Committee at a meeting with Government officials in Washington last month. Other topics discussed at the meeting were the supply of fluorescent lamps for replacement and new fixtures, and the ballast and transformer situation.

The demand for small transformers needed for combat equipment is very heavy, the Committee was informed. These transformers and those used for fluorescent lighting fixtures are made by the same manufacturers, and production cannot be increased substantially because of the limited supply of manpower with the necessary skill to make either type. These factors limit the supply of transformers and ballasts for lighting fixtures.

Fluorescent lamps are available in sufficient quantities to take care of demand for replacements and for new fixtures, provided that the production of new fixtures continues at the present rate. But



FUSE PROTECTION is the common subject of H. F. (Jack) Williams, service engineer, Bussman Mfg. Co., St. Louis, and Charles Munsch, maintenance electrician, American Steel Foundry Co., Granite City, Ill., at a recent maintenance electricians meeting in St. Louis.

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A WASTEFUL BROADSIDE *from your company*

CAN CRIMP A NAVY BROADSIDE

Against the Japs

YOU BET IT CAN. For the ammunition which our fleet fires reaches its destination protected by paper. And the paper you waste in an ornate, unnecessarily large advertising broadside is just what the Navy and the Army need to do their job.

That's why Uncle Sam asks you to watch every company project in terms of **USING LESS PAPER**. Whether it's a direct mail piece or a letter or a paper-board container—think of it as a challenge to you and to your colleagues. Yes, a challenge to you to see how you can carry on your business and

at the same time cut down and cut down and cut down on your company's use of paper.

Remember the whole country is being enlisted in this drive. You'll be a soldier in a mighty army of paper conservers.

And remember, right now, there's no home-front conservation job any more urgent or important than the conservation of paper and paper board.

If your company or your community has not yet organized Paper Conservation Committees, why not start them yourself and now?

Use Less Paper Because

Each 500-pound bomb takes 12 pounds of paper for rings, tops and bottoms.

A fiber container for a 75-millimeter shell takes 1.8 pounds of paper board.

Each weapon part must be wrapped in grease-proof paper and in waterproof paper. A single shipping case of decontaminating apparatus requires 273 square feet of waterproof lining paper.

All kinds of paper are used by the Army, from vegetable parchment, .0015 inches thick, to heavy paper board and wallboard.

Use Less Paper These Ways

Use smaller type sizes and margins. (Any competent printer, in consultation, can point the way to pronounced savings by these means.)

Reduce separators to shoulder height.

Eliminate top and/or bottom pads in every practical instance.

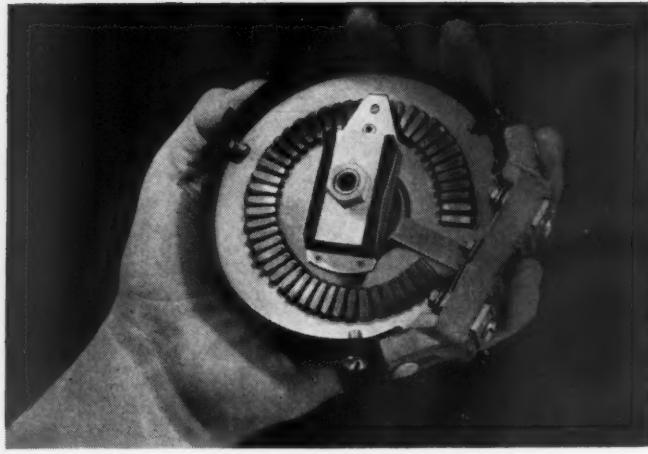
Make scratch pads from stocks of obsolete letterheads, memorandum forms, and other unused inventory.

Cut the weight of paper stocks. (You tell the printer how long you expect a record to endure and he can tell you what stock to order.)

This advertisement prepared under the auspices of the War Advertising Council
in co-operation with the Office of War Information and the War Production Board.

LET'S ALL USE LESS PAPER

Space for this advertisement contributed by ELECTRICAL CONTRACTING



A SMALL RHEOSTAT with **BIG** FEATURES

Ward Leonard has produced their 4" Plate Type Rheostat with all the desirable features of their largest equipment. It dissipates heat from both sides. The contacts are solid metal blocks for durability. Action is

smoothness itself. There are forty-three steps of control. Data Bulletins are available on the various Ward Leonard Rheostats. Write for bulletins describing the size and type of Rheostats of interest to you.

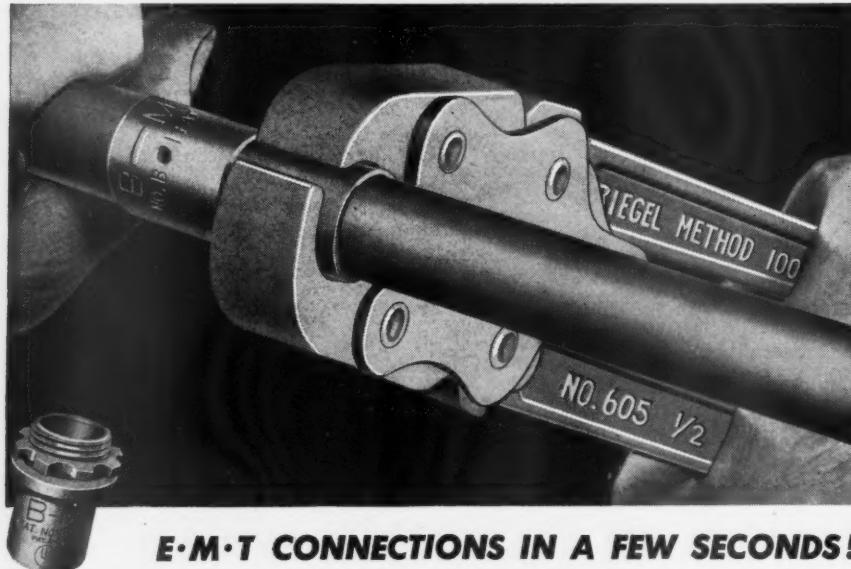


WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control devices since 1892.

WARD LEONARD ELECTRIC CO., 28 South St., Mount Vernon, N. Y.



E·M·T CONNECTIONS IN A FEW SECONDS!

With B. M. Fittings



TWO QUICK SQUEEZES give you Finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then too, they are stronger, neater and much easier to work with in tight places. Start using B-M Fittings today. Have more satisfied customers—more profits from each job! (All B-M Fittings carry the Underwriters Seal of Approval)

Prompt Deliveries on Properly Rated Orders



BIEGEL METHOD TOOL CO. • Galva, Ill.

DISTRIBUTED BY

The M. B. Austin Co., Chicago, Ill.
Clayton Manufacturing Co., Evanston, Ill.
Coffelt Conduit Co., Jersey City, N. J.
Gen. Electric Co., Bridgeport, Conn.
The Steedlett Co., Youngstown, Ohio
Enamelled Metals, Pittsburgh, Penn.
National Enameling & Mfg. Co.,
Pittsburgh, Pa.
Triangle Conduit & Cable Co.,
New Brunswick, N. J.

any rapid large-scale increase in lamp production is not possible because of the scarcity of certain components and the limitations imposed by present production facilities.

The use of substitute materials as a wartime measure has resulted in many cases in inferior products, and WPB is making studies relating to future adjustments in limitation orders which now require the use of substitute materials, the committee was informed. The Lighting and Fixtures Section of the Building Material Division has been asked to present data pertinent to these studies.

SCHEDULE II TO ORDER L-126 REVOKED

Specifications for refrigeration condensing units for industrial and commercial refrigeration and air conditioning machinery and equipment were revoked by the War Production Board.

The most important feature of the action was the removal of the prohibition on the use of steel in the construction of bases for refrigeration condensing units having motors over 20 horsepower in size. Revocation of this restriction will save valuable manhours formerly required to erect concrete bases at the time of installation of the unit, WPB explained.

The original purpose of this provision was to conserve steel, but now that the type of steel required is generally more available, it is considered more important to conserve manpower.

The action which revoked Schedule II to Order L-126, Industrial and Commercial Refrigeration and Air Conditioning Machinery and Equipment, also removed standardization restrictions which limited the number of models that each manufacturer could produce. Since a



H. E. SOMES, chief engineer of Budd Induction Heating Inc. presented a paper at AIEE Winter Technical meeting in New York City on induction heating application at their plant, pointing out its important advantages in selective and non-selective heating.

Are you properly
emphasizing the
SAVINGS FEATURE
OF YOUR PLANT'S PAYROLL
SAVINGS PLAN?



WITH the war swinging into its tensest phase, now's the time to emphasize over and over again the *savings* feature of your Payroll Savings Plan. To press home to all your people the need of building up their savings—the need of building up their savings not only in wartime but also in the years directly after the war. To point out that a bond cashed before its full maturity is a bond killed before it has given its fullest service to its

owner—or to *his country*!

Buying War Bonds, holding War Bonds, and keeping wartime savings mounting—all are absolutely vital. But no one of these is enough by itself. The *savings habit* must be carried over into the years of reconstruction which will follow the war. For if, at war's end, we have 'flash-in-the-pan' spending, everybody loses. The spender loses, you lose, and the country loses! While a working public, convinced of

the value of continued, planned saving, is the soundest possible foundation for private enterprise of every sort.

We call these bonds War Bonds—and with their aid we will win this war at the earliest possible moment! But they're Peace Bonds, too—and, rightly used, they will win for their holders, *and for all of us*, a happy and prosperous place in the years of peace to come.
WAR BONDS to Have and to Hold.

The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL CONTRACTING

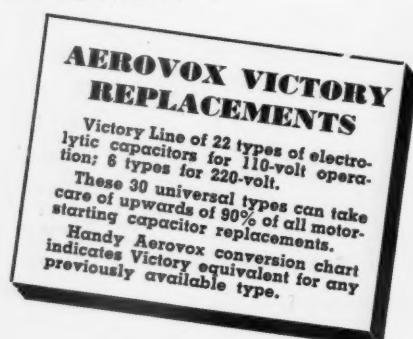
★ **Let's All Back**
★ **the Attack...**
★ **with War Bonds!**

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council



VICTORY· motor-capacitor REPLACEMENTS

The Aerovox Victory Line is the answer to wartime conditions and restrictions. A drastic reduction in number of types has been achieved without impairing satisfactory servicing. You can keep those electric refrigerators running for the duration, with these replacements . . .



SEE OUR JOBBERS . . .

They carry a stock of these Victory replacements. Ask to see the conversion chart. Or write us direct.



AEROVOX CORP., NEW BEDFORD, MASS., U.S.A.
In Canada AEROVOX CANADA LTD., HAMILTON, ONT.
Export: 13 E. 40 St., NEW YORK 16, N.Y. Cable: 'ARLAB'

large percentage of the units now being produced are for military use and since these produced for the Army, Navy, and Maritime Commission were exempted from model standardization, it was felt by WPB that these restrictions were no longer necessary.

LIMITATION ORDER L-298 AMENDED

The War Production Board has announced that application for the purchase of resistance welding equipment will continue to be accepted on Form WPB-2752 only until March 15, 1944.

After that date all such applications must be submitted on Form WPB-1319. These forms have been valid since February 16, 1944. This action is covered in an amendment to Limitation Order L-298.

CMP REGULATION NO. 9A MODIFIED

Repairmen may use only up to \$25 worth of material purchased under procedures contained in Controlled Materials Plan Regulation No. 9A for installing any unit of cooking, plumbing, heating or used air-conditioning or refrigeration equipment, the Controlled Materials Plan Division of the War Production Board has announced.

However, if a new air-conditioning or refrigeration system has been authorized under the provisions of Limitation Order L-38 and authorization to construct has been granted under the terms of construction Order L-41, a repairman may

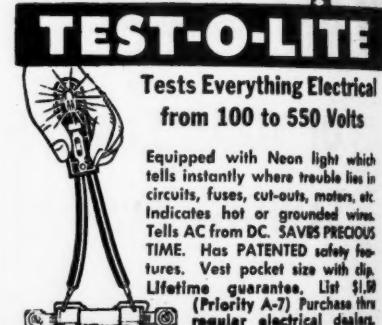


HARRY A. OFFUTT, vice president and estimator for Enterprise Electric Co., Baltimore, Md., follows all his jobs closely in every detail. One of the most interesting installations was a 25,000 foot concentric cable job recently completed.



SAFETY RULES call for that EXTRA PRECAUTION and additional RE-CHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages . . . prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.



L. S. BRACH Mfg. Corp.
55-63 Dickerson St., Newark, N.J.

110-Volts A.C. from Direct Current

On the Fighting Front On the Home Front
with KATOLIGHT ROTARY KONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.



KATO ROTARY KONVERTER, 225 Watts
Good deliveries on rotary converters 35 through 1500 watts. Quiet in operation. Can be furnished with special filtering equipment for sensitive radio work.

Pioneers in the Building of Small Rotary Converters

At present Kato's entire production must be directed to furnishing converters on high priority orders. Write us if you need this kind of equipment for war orders. Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.
628 N. Front St., Mankato, Minnesota



WM. G. STOCKHAUSEN (left) electrical contractor and owner of Central Electric Co., Baltimore, Md. Bill recently engineered and installed the hi-voltage to load center distribution system of Chas. T. Brandt, Inc., manufacturers of prefabricated sheet metal structures. He is in discussion here with A. J. Huber, chief electrician for Brandt.

use up to \$250 worth of material purchased under CMP Regulation No. 9A to install the new system.

These general rules, which are contained in Direction No. 2 to CMP Regulation No. 9A, do not increase the overall amounts of materials that repairmen are permitted to purchase under the CMP Regulation No. 9A procedure.

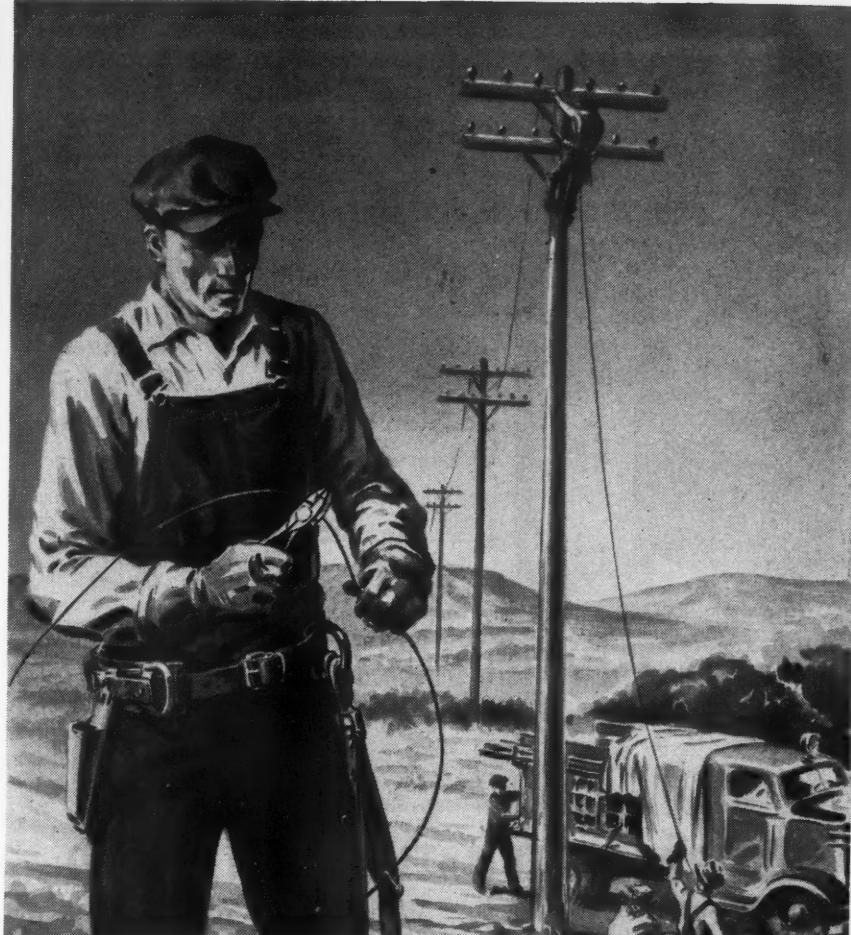
Previously repairmen who desired to make these types of installations were required to file specific applications with WPB for the materials needed to make each such installation. Under the modified procedure, this is no longer necessary, unless the repairman needs more materials than the specified limits permit to make the specified installation.

UTILITIES ORDER U-1-i AMENDED

Acting to assure increased food production in areas dependent upon irrigation systems, the Office of War Utilities has provided for extensions of electric power to water pumps that serve to irrigate at least five acres of land each.

Supplementary Utilities Order U-1-i, as amended, sets forth the conditions under which such electrical connections may be made. An applicant must secure from his County Agricultural Conservation Committee a certification to the effect that he is eligible under the terms of the new order and that in the opinion of the committee the connection requested will result in a substantial increase in farm production. This certification must accompany the application to be addressed to the utility company which will supply the power.

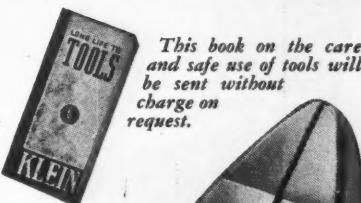
A limitation of \$1500 is imposed on any extension of service which may be made. Other restrictions confine new connections to consumers owning electrically driven irrigation pumps of at least 25 gallons per minute capacity and to those who can obtain such a pump without



TOMORROW'S LINEMEN WILL BE KLEINMEN, TOO

STRINGING wire is tough work. Men in the armed forces who have had to keep communication lines open under battle conditions know how good tools and equipment can aid them in their job. Today, Klein is producing this essential equipment for the Army and Navy and for war industries at home.

When the war is won and these Kleinmen return to their peacetime tasks, they are assured of the same high quality in their belts and straps—climbers and grips—pliers and wrenches that they knew before the war—the same high quality that is serving them today. They will recognize the name Klein as standing for the finest in tools and equipment.



This book on the care and safe use of tools will be sent without charge on request.



Since
1857

ASK YOUR SUPPLIER
Foreign Distributor:
International Standard Electric Corp., New York

Mathias **KLEIN** & Sons
Established 1857
Chicago, Ill., U.S.A.
3200 BELMONT AVENUE CHICAGO 16 ILLINOIS



RELIANCE

Automatic TIME SWITCHES

for any installation . . .



RELIANCE Model W

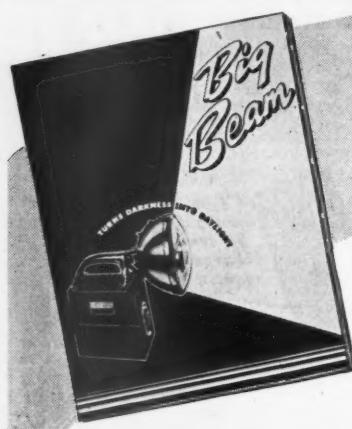
Electric Time Switches are completely automatic—extremely simple, compact, economical—three types cover practically every requirement. Made in single pole, double pole, and two-circuit types—30 ampere per pole.

★ ★ ★

**Write for catalog 300 or see your Wholesaler
Prompt Delivery on Orders Rated AA-5 or Higher**

**RELIANCE AUTOMATIC LIGHTING CO.
1937 Mead St.**

Racine, Wis.



BIG BEAM CATALOG

**will be ready
for distribution
SOON . . .**

We have prepared this very interesting and comprehensive catalog on BIG BEAM Portable Electric Rechargeable Hand Searchlights and Accessories to give you important details and facts that will help you do a good selling job.

A Preview OF CONTENTS

Descriptions and Specifications on

No. 700 2000-foot-beam Dry Cell Battery Portable Searchlight

No. 700 EH Portable Electric Hand Searchlight

No. 411 Portable Electric Rechargeable Hand Searchlight

New Streamlined No. 1000 all-purpose Electric Hand Searchlight

No. 700D Dual Head Railroad Portable Searchlight

No. 500R Hand Car Searchlight

Also

Method of recharging

Cutout view of BIG BEAM Searchlight

Accessories

Partial scope of BIG BEAM uses

U-C LITE MFG. CO.

11 EAST HUBBARD STREET
CHICAGO 11, ILLINOIS

priority assistance or to whom a preference rating of AA-5 or better has been assigned for the delivery of one.

By permitting county agricultural conservation committees and utility companies to operate under this decentralized authorization, it is expected to eliminate paperwork previously involved in making individual appeals to Washington and to speed up installation of service to producing growers.

LIMITATION ORDER L-112 AMENDED

The War Production Board has amended Limitation Order L-112 to eliminate reference to information that should be supplied when filing WPB Form 1319 for authorization to sell, transfer or convert industrial power trucks. Hereafter WPB Form 1319 shall be filed in quadruplicate and shall contain information called for by current instructions which will be available with the form.

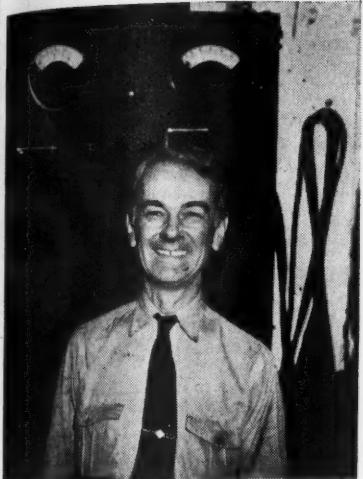
DIRECTION NO. 13 TO CMP NO. 5 REVOKED

Rules governing maintenance, repair, and operating supplies, (MRO) under the Controlled Materials Plan have been amended to provide that if an appeal for an increased MRO quota has been granted by the War Production Board, the increased quota may be used for operations during quarters subsequent to the one for which it was originally granted. This rule holds unless a substantial part of the increased quota was granted to take care of an abnormal situation. For example, where a person's quota has been increased to permit him to purchase a large amount of special tools and equipment to produce



JUSTLY PROUD of the record breaking membership and attendance of the Milwaukee Electrical Maintenance Engineers group are its officers (L to R) president, A. L. Krumbaum, power superintendent, Globe Steel Tube Co.; and secretary, H. M. Eversz, maintenance superintendent, McCulloch Engineering Company.

Electrical Contracting, April 1944



RAY M. SPAHR, foreman of the electrical department, Geo. F. Motter's Sons, York, Pa. In addition to the manufacture of printing machinery and wholesaling electrical and mill supplies, Motter's does an extensive mechanical and electrical maintenance business for industrials and maintains a large motor repair and machine shop.

a new product, the increased quota may not be used in quarters subsequent to the one for which it was originally granted.

The amended regulation points out that persons who use its provisions to obtain MRO materials must compute their MRO quotas and must maintain a record of them on file. In addition, it points out that records of expenditures against the quota must also be maintained. As a result, Direction No. 13 to CMP Regulation No. 5, which formerly required that quotas be computed, has now been revoked in view of the fact that the provisions are now spelled out in CMP. Regulation No. 5 itself.

VULCANIZED FIBRE PROHIBITED IN NON-RENEWABLE FUSES

WPB has prohibited the use of vulcanized fibre tubing in the manufacture of non-renewable fuses rated at 60 amperes or less. The tubing is required in great amounts by the Navy. It may be used for Navy fuses, fuses rated 61 amperes or more, those rated 600 volts or more, time-delay non-renewable cartridge fuses and non-midget fuses for the Maritime Commission.

AMENDMENT NO. 7 TO OPA SCHEDULE NO. 82

The maximum price for sales of wire, cable, and cable accessories by wholesalers and jobbers, to industrial, commercial and governmental purchasers has been limited to 120 per cent of the manufacturer's net price to wholesalers in the same quantities, the Office of Price Administration has announced.



The FRAHM VIBRATING-REED HAND TACHOMETER requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine with which the instrument is held in contact.

This principle and the method of indication are unique among speed measuring instruments. The Frahm Tachometer is as accurate as it is simple, with no parts to wear, adjust, lubricate or renew. It can be used in any position and will give years of trouble-free service. For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 to 30,000 r.p.m.

For a complete description of Frahm Tachometers together with lists of types and ranges commonly supplied, write for Bulletin 1710-EC.

The JONES HEAVY DUTY HAND TACHOMETER is used for indicating r.p.m. and surface speeds of all types of machinery in which the

moving parts are readily accessible. Simple, rugged and reliable, it is built to maintain accuracy in hard, everyday service. Scale has equal divisions throughout the 360 degrees of pointer deflection. The instrument can be operated in either direction of rotation and in any position. Single and triple range models up to 12,000 r.p.m. supplied complete with carrying case and accessories.

Write for descriptive Bulletin 1710-EC.



JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

"tops"
For Keeping Motors
in **tip-top**
Condition

IDEAL
MOTOR
MAINTENANCE
TOOLS



IDEAL RESURFACERS

Keep motors and generators on the job, piling up new production records. Refinish Commutator and Slip Ring surfaces to original efficiency without dismantling. Sizes and grades for all conditions.

IDEAL PRECISION GRINDERS



Used when surfaces are badly scored and out-of-round. Portable. Mount on Motor Frame —no disassembly.

IDEAL MICA UNDERCUTTERS



Undercut the hardest Mica without removing armature. Four models to fit all conditions.

FREE . . . Send today for

**New
IDEAL
Maintenance
Handbook**

88 illustrated pages — Motor Maintenance and Repair Equipment.

IDEAL Sycamore

IDEAL COMMUTATOR DRESSER CO.

1041 PARK AVE. SYCAMORE, ILL.
Sales offices in all principal cities
In Canada: Irving Smith Ltd., Montreal, Quebec

The limitation applies regardless of the number of sellers handling the product before it reaches the user.

This action, effective March 21, 1944, was taken by OPA to stop pyramiding of distributors' mark-ups—a practice which has arisen in the industry since the war emergency.

There are some cases where wholesalers are directed by the War Production Board to purchase available stocks of wire, cable, and cable accessories from sources other than the manufacturer. If, in these and comparable situations, the new ceiling inflicts unreasonable hardship, relief may be granted upon individual application for adjustment, OPA said.

Amendment No. 7 to Revised Price Schedule No. 82—Wire, Cable, and Cable Accessories.

**MORE ELECTRIC MOTORS
FOR AIRCRAFT NEEDED**

Production of small electric motors for aircraft use will not be sufficient to meet present programs, according to members of the Fractional Horsepower Motor Industry Advisory Committee members, unless additional manpower and some additional facilities are made available, the War Production Board has reported.

In addition to their warning on manpower and facilities, members of the committee also pointed out that while supplies of ball bearings were improving, the quantity available did not meet present requirements.

Officials of WPB assured the committee that action is now being planned to provide additional manpower and facilities.

The committee also reported that while production of standard alternating cur-

rent motors for use in civilian products is increasing steadily, the supply available for products just coming onto the market is decreasing since presently programmed production for aircraft and essential civilian requirements utilizes more and more of the existing production facilities.

**LIMITATION ORDER
L-327 ISSUED**

The War Production Board has restricted the manufacture of lighting equipment for aircraft to equipment certified by the Aeronautical Board or (in the case of equipment over which the Board exercises no jurisdiction) certified by the Army Air Forces, the Bureau of Aeronautics of the Navy, or the Civil Aeronautics Administration.

Aircraft lighting equipment not so certified may be manufactured, sold and delivered (1) for the maintenance and repair of existing aircraft only the extent that certified items cannot be used for such replacement; (2) for purposes of research, development, and test of items not yet certified; and (3) as specifically authorized by the War Production Board.

Restrictions on manufacture also apply to installation of equipment.

This action, taken by Limitation Order L-327 which becomes effective on April 10, 1944, is designed to standardize and simplify aircraft lighting equipment, and to eliminate substandard items and obsolete items except as required for maintenance and repair.

The order covers landing lights, position lights, instrument lights, signal, indicator and approach lights, and other items of aircraft lighting equipment. It does not cover gunsights and bombsights, indicator lights that are an integral part of radio and electronic apparatus, pyrotechnic devices, or aviation ground lighting equipment.

A table of acceptable aircraft lighting equipment accompanies the order as an informational supplement drawn up for the guidance of the industry.

**ORDER L-41
REVISED**

The War Production Board has announced a minor revision of Order L-41, the overall order limiting construction, to make it conform with other recently amended MPB orders also concerned with construction.

Only two substantive changes are made as follows:

(1) On airport construction, the limit allowed without getting WPB permission for any job begun in the same year is placed at \$1,000 as against the limit of \$2,000 which formerly held, and

(2) The exception previously given to the installation of plumbing and heating equipment rated on WPB form 263 (formerly PD-851) is revoked. Hereafter, WPB permission under Order L-41



EFFICIENT OPERATION of the electrical facilities at Anheuser-Busch Company's St. Louis, Mo., plant is the responsibility of chief electrician Herman J. Sexauer (left) and assistant chief Frank Yung.



RAYMOND C. BECK, electrical contractor and field representative for Enterprise Electric Co., Baltimore, Maryland has been doing a great selling job all over the country for everything from industrial wiring jobs to pole-line and tower work.

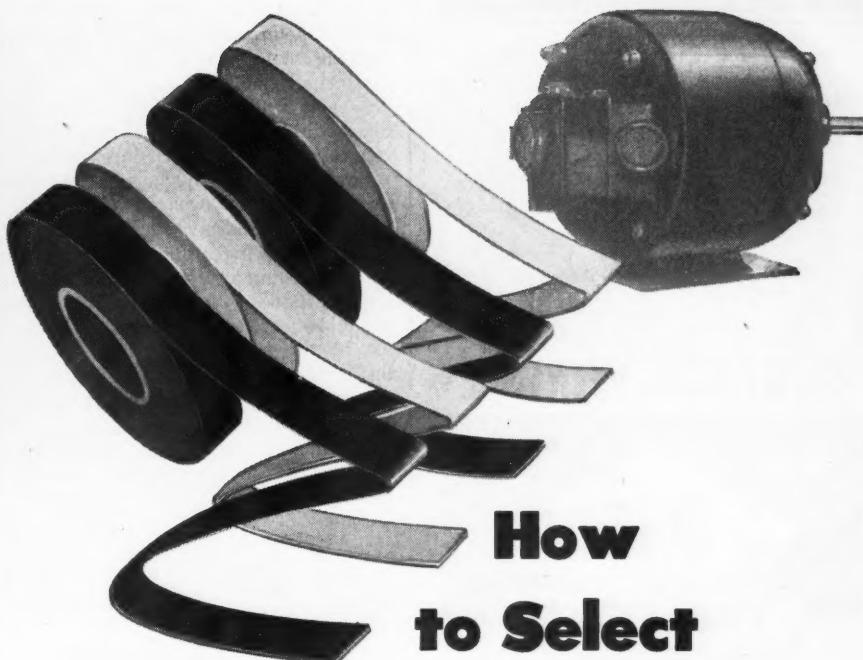
will be necessary on all plumbing and heating installations where the cost of the construction including the cost of the equipment is in excess of the L-41 cost limits. Applications for this type of construction must be made on WPB form 286.

Other revisions merely clarify or reflect recent changes in procedures.

P.C.E.A. DEVELOPING A WIRING APPRAISAL CHART

Because building and loan agencies and banks have had no yardstick by which to judge how much should be allotted for an adequate wiring installation they have made no inquiries into the prospective home builders' plans in this respect. Having found this to be a fact, the adequate wiring committee of Pacific Coast Electrical Assn. has set about to develop an adequate wiring appraisal chart for the use of banks and building and loan associations. Building and loan people consulted on this matter have declared it is just what they are looking for.

The appraisal chart, which is still in process of being developed, is set up for homes costing less than \$8,000, it being presumed that those costing greater amounts will be engineered or will have an architect provide for adequate wiring. It is worked out on a basis of 4 percent of the total cost being allotted to a fully adequate job of wiring. Thus, a \$5,000 home would have an allotment of \$200, a \$6,000 home \$240 or an \$8,000 home \$320. To determine whether the full amount should be loaned to a prospective builder the plans would be checked against the adequate wiring specifications to see whether it provided for the various parts of a wiring installation. These parts are assigned in point value, total of 400 being required for the full loan allotment. Thus the basic main service would get one-eighth of the apportionment or



How to Select **INSULATING TAPES**

Keep these facts in mind when selecting insulating tape:

A. The base cloth must: (1) have ample mechanical strength; (2) be chemically inert; (3) contain minimum sizing to permit thorough penetration by the insulating varnish and prevent weakening of the fiber in service.

B. The varnish must: (1) be neutral in relation to the cloth; (2) impart maximum dielectric strength, flexibility and resistance to heat, oil, water or other damaging agents against which the particular tape is to give protection.

C. A ready source of supply for all types of insulating tapes must be available. Your local G-E distributor handles a complete line of tapes, as well as all other insulating materials, and can furnish detailed data and catalog on request. Or send for catalog to Section M442-8, Resin and Insulation Materials Division, General Electric Co., Schenectady, N. Y.

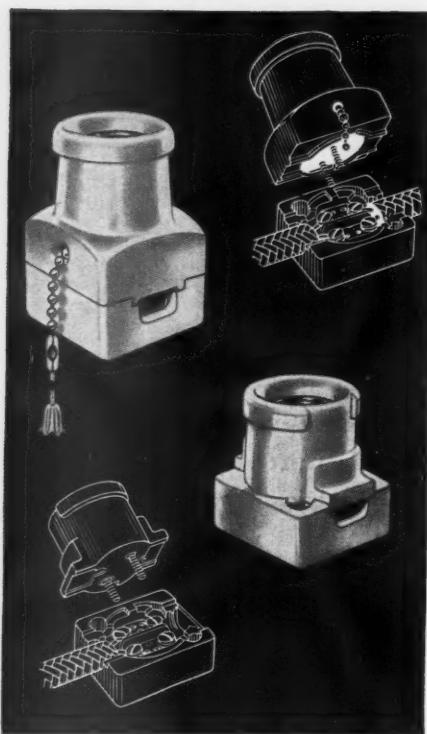
★ BUY WAR BONDS ★

GENERAL  **ELECTRIC**

*For Faster
- Easier -
Dependable*

SURFACE WIRING

Use
P&S
CABLETTES



For farm buildings, outbuildings, attics and basements.
Note the simplicity of design
— Ease of wiring and assembly
— No boxes, clamps, connectors
or soldering.

PASS & SEYMOUR
INCORPORATED
SYRACUSE 9, N. Y.

50 points, lighting wiring one-eighth or 50 points, convenience outlet wiring seven-tenths or 70 points and other parts of the installation such as switch wiring, doorbells, range wiring, water heater wiring, bathroom heater and wiring a various range of points. The points ascribed to range wiring would include the necessary main service capacity and protective equipment. Additional convenience outlets would be given additional allotments.

The committee believes this is the first check chart of this kind to be made available to loaning agencies as a guide to requiring wiring adequacy. Such financing agencies are more keenly aware of the permanent value of an adequate wiring installation both as a guarantee of satisfaction of the home owner who makes the loan and of resale of the property in case of repossession.

MASSACHUSETTS ADOPTS LATEST SUPPLEMENTS TO 1940 CODE

The Massachusetts State Examiners of Electricians has rescinded its previous adoption of the 1940 Code and its first Supplement and adopted the following recommendations:

All persons, firms and corporations entering into, engaging in or working at the business of installing wires, conduits, apparatus, fixtures or other appliances for carrying or using electricity for light, heat or power purposes within the Commonwealth of Massachusetts shall be governed by all general and special laws and municipal ordinances, by-laws and regulations now or hereafter in force and applicable thereto, and in respect to all matters not therein expressly provided shall, on and after February 1, 1944, be governed by the standards set forth in the 1940 National Electrical Code for Electric Wiring and



MAINTENANCE MEN of the Industrial Division, St. Louis Electrical Board of Trade, have as their chairman G. J. Wesmeyer who, in everyday life, is chief of electrical maintenance for the Gaylord Container Corporation, St. Louis, Mo.



PSYCHOLOGY AND LIGHTING shared the spotlight at electrical maintenance panel of Indianapolis War Production Clinic. Prof. M. F. Stiger, Purdue University (left) discussed the three "C's" of maintenance—Cause, Cost, Control, while R. M. Brown, director, lighting sales, Indianapolis Power & Light Co., handled the lighting questions.

Apparatus, as amended by the Supplement to said 1940 National Electrical Code dated April 1, 1943, both as published by the National Board of Fire Underwriters on recommendation of the National Fire Protection Association copies whereof, duly attested by the general manager of said association are on file with the Secretary of the Commonwealth and with this Board.

BURKE HAS PURCHASED ELECTRICAL ENGINEERING CO.

Grover Burke, Seattle electrical contractor, has purchased the stock and fixtures of Electrical Engineering Co., 110 Marion St., from James Maitland, who has handled the business since 1900. Burke will combine the business with that of City Electrical & Fixture Co. The deal involves representation in the area of Landers, Frary & Clark on Universal electric appliances; Hamilton Beach & Co. and Silex. With it Burke purchased a large building. Burke is the executive committeeman for Division 10 of the National Electrical Contractors Assn. and president of the Seattle Chapter.

BUTCHER OPENS NEW MOTOR SHOP

Roy M. Butcher, electrical contractor of San Jose, Calif., in moving to a new office and shop at 510 West San Fernando St. is opening a motor rewinding shop. Butcher has formerly done straight electrical contracting but his recent large volume of big jobs has outgrown his unique office and shop at the rear of his home in San Jose. When erecting a large modern home for himself some years

ago, Butcher built his shop to resemble a large double garage at the rear of the property and concealed the entrances for his trucks by shrubbery to make the shop acceptable to a residential neighborhood. Butcher is chairman of the California State Contractors License Board and a director on the Northern California Chapter, NECA.

NECA ADOPTS STANDARDS FOR ELECTRONIC EQUIPMENT

The Electronics Section of the National Electrical Manufacturers Association has adopted new standards for electronic equipment for induction and dielectric heating.

The complete text of the standards is as follows:

EL 5-5 Output Ratings

The following output ratings for Electronic Induction or Dielectric Heating Units shall be considered as preferred:

| | |
|----------|-----------|
| 0.5 kw. | 20.0 kw. |
| 1.0 kw. | 50.0 kw. |
| 2.0 kw. | 100.0 kw. |
| 5.0 kw. | 200.0 kw. |
| 10.0 kw. | |

These ratings are recommended until there is need for intermediate sizes.

Suggested Standard for Future Design 1-18-44

EL 5-10 Ratings of Tubes and Parts

Electronic tubes and other component parts of electronic induction or dielectric heating units shall be used within the manufacturer's ratings.

Recommended Standard 1-18-44

EL 5-15 Radio Interference

Electronic induction or dielectric heating apparatus shall be so designed and installed as to minimize radio interference.

Recommended Standard 1-18-44

EL 5-20 Protection of Personnel

Electronic induction or dielectric heating apparatus shall include provisions for protecting the operating personnel against dangerous voltages.

Recommended Standard 1-18-44

EL 5-25 Protective Equipment

Installations of electronic induction or dielectric heating apparatus should include protective equipment such as fuses, relays and/or circuit breakers, acting to disconnect the apparatus from the supply line in case of failure or flashover of internal components.

Recommended Standard 1-18-44

EL 50-5 Induction Heating—Definition

Induction heating is the heating of a nominally conducting material due to its own IR losses when the material is placed in a varying electro-magnetic field.

Adopted Standard 1-18-44

EL 50-10 Dielectric Heating—Definition

Dielectric heating is the heating of a nominally insulating material due to its own dielectric losses when the material is placed in a varying electric field.

Adopted Standard 1-18-44



SEE-Power for the Pacific Front -in a hurry!

IN a matter of minutes, four powerful motors will break into a full-throated roar, and this vital cargo of Goodrich lights will go streaking high above the blue waters of the Pacific. Their destination—and the specific uses to which they will be put—are military secrets. But you can bank on this: Goodrich lighting serves Uncle Sam's forces faithfully and well with porcelain enameled finish that defies corrosion in any climate.

That's the thing about Goodrich porcelain enameled equipment... the finish is permanent, unaffected by climatic conditions. Glass is fused into the metal to become a part of it, assuring complete protection for the underlying surface. Even after years of service, they're good as new.

Goodrich porcelain enameled lighting, designed in hundreds of sizes and styles, is serving the war effort everywhere, indoors and out.

Sold through electrical wholesalers



HIGHLITE



STOCKLITE



REFLECTO FLOODLIGHT



RLM DOME

GOODRICH

ELECTRIC COMPANY

4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

ILLINOIS

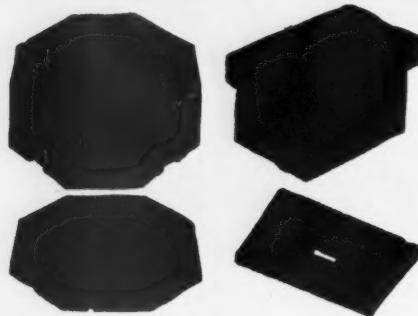
Completely Insulated

ALL PORCELAIN WIRING SYSTEMS

Save Critical Materials

Save Installation Time

Cut Maintenance



★ An ILLINOIS Porcelain System enables you to do an outstanding modern wiring job—you are afforded every advantage in making easier, safer, more convenient, and efficient layouts—you can guarantee these porcelain systems for longest service life, for safety, and for greatest all round satisfaction. Porcelain does not rust or corrode. It is a logical wiring material because it conserves steel, zinc, copper, rubber. Grounding is unnecessary when you use this system. Clamps are not required for porcelain boxes. When you sell your next wiring, sell an ALL Porcelain System.



Bull Dog

**ILLINOIS
ELECTRIC PORCELAIN
COMPANY**
Macomb, Illinois

MANUFACTURERS NEWS

WESTINGHOUSE APPOINTMENTS

William D. Turnbull, who has been vice president and sales manager of the Pomona Pump Company of California, has been appointed manager of the Westinghouse Electric and Manufacturing Company's Agency and Specialties Department. Before joining the Pomona Pump Company in February, 1940, he was manager of the Westinghouse Machinery Electrification Section.

Ira B. Stiefel has been named assistant to the vice president in charge of Industrial Relations for Westinghouse. Mr. Stiefel has been manager of Industrial Relations at the Company's East Pittsburgh Works since 1937. His new headquarters will be in downtown Pittsburgh.

Frank R. Benedict has been appointed manager of product performance analysis of Westinghouse. As head of the newly created product performance analysis section at the East Pittsburgh plant, he will work under the direction of M. B. Wyman, manager of the District Engineering and Service Department.



TURNBULL

Crocker-Wheeler Division of the Joshua Hendy Iron Works, Ampere, N. J., has appointed Lyman D. Warner

as successor to C. F. Poirier, sales manager and assistant vice president. Mr. Warner was formerly assistant sales manager. He has been associated with Crocker - Wheeler's sales department since 1937. Prior to his connection with Crocker-Wheeler he was associated with the Ingersoll Rand Company and the General Electric Company in Schenectady, New York and Chicago.



WARNER

SYLVANIA PROMOTIONS

The Lighting Division of Sylvania Electric Products, Inc., announces the appointment of William C. Pirie as assistant advertising manager in the office of John P. Waters, manager of Lighting Division advertising at 500 Fifth Avenue, New York. He was

formerly assistant sales promotion manager.

John B. Stevenson, formerly in the Boston sales office, is the new assistant advertising manager in the same division, in charge of the advertising office at Salem, Mass. He succeeds James R. Duffy, who has become manager of employee activities in the company's industrial relations department.

The Radio Tube Division of Sylvania has named W. G. Patterson as manager, Distributor Sales, California Division. He will report directly to R. P. Almy, manager, Distributor Sales. Mr. Patterson's headquarters are located in the Richfield Building, 555 South Flower Street, Los Angeles, Calif.

ALLIS-CHALMERS CHANGES

T. C. Knudsen has been named manager and chief engineer of the new Texrope Department established by Allis-Chalmers Mfg. Co., Milwaukee, Wis.

A. D. Robertson has been appointed assistant manager of the motor division at its Norwood Works, Norwood, Ohio.

REVERE ELECTRIC CHANGES

Revere Electric Manufacturing Company and the Revere Electric Supply Company are no longer related either through common management or stock ownership.

Van N. Marker, president of Revere Electric Manufacturing Company, will devote his entire time to the manufacturing business.

F. R. Eiseman, who was secretary and treasurer of both of the above companies, will devote his entire time to the supply business. He is now president of Revere Electric Supply Company.

PENNSYLVANIA TRANSFORMER APPOINTMENTS

Pennsylvania Transformer Company of Pittsburgh, announces the appointment of J. J. Costello Co. as sales representative in New England territory with offices in Boston, Mass. and New Haven, Conn.

J. F. Joyce has been named district sales representative with offices in Cleveland, Ohio.

United States Rubber Company has named W. S. Long, formerly operations manager of the Company's Los Angeles plant, as Pacific Coast Sales manager, mechanical goods. Mr. Long will continue in charge of war products activities on the Pacific Coast.

J. M. Miller will continue as factory manager of the Los Angeles plant.

ELECTRIC MACHINERY ELECTIONS

W. H. Feldman, vice president and general manager since 1940, has been elected president and general manager of Electric Machinery Mfg. Company of Minneapolis, Minn.

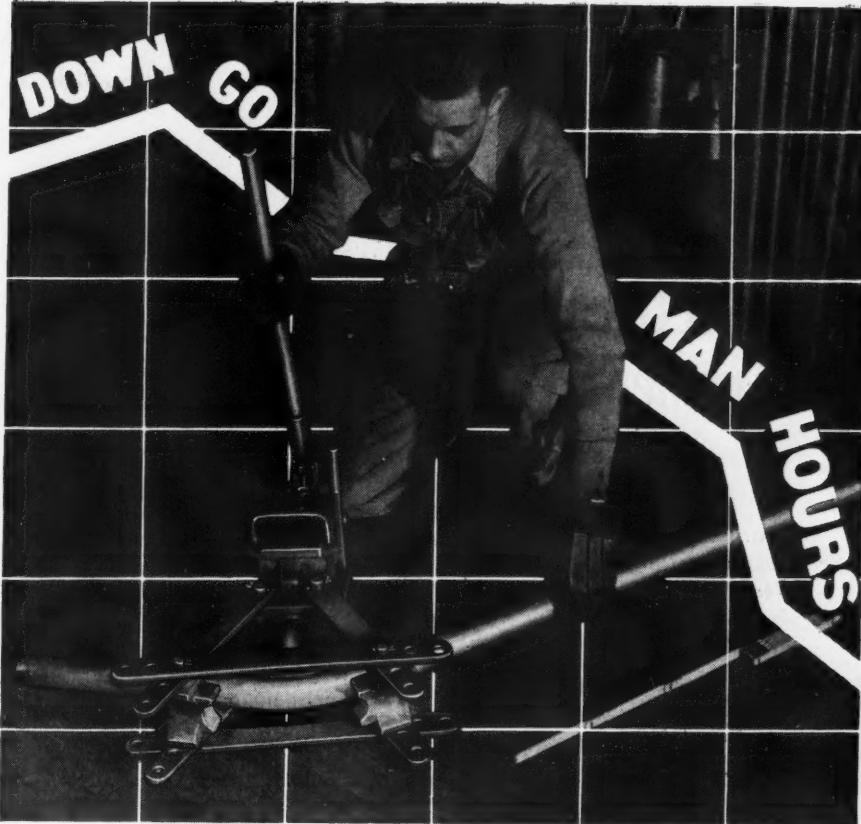
Silas McClure, president since 1921, was elected to the chairmanship of the board of directors.

Acme Electric & Manufacturing Company, Cuba, New York has appointed H. R. Hopkins Company, Delaware Avenue and Brown Street, Philadelphia, to handle the lighting transformers and ballasts, including cold cathode lighting transformers. Their territory will include eastern Pennsylvania, southern New Jersey and Delaware.

Electric Service Supplies Co. of Philadelphia has changed its name to Electric Service Manufacturing Co. The change in name does not affect the ownership or management of the Company. A. H. Englund, executive vice president, was recently elected president and J. R. McFarlin, electrical engineer is now secretary.

Chrysler Airtemp Corp. has named J. J. Donovan as regional manager of the New York office. He will direct Airtemp sales and service activities in the greater New York area and New England.

The Paine Company of Chicago, announces the appointment of E. M. Joesam & Co., 208-210 Purchase Street, Boston, Mass., as New England distributor.



...when you bend pipe with a GREENLEE

TIME-SAVING TOOLS FOR ELECTRICAL WORK

BENDERS. Complete line of powerful hydraulic and hand benders for every bending job; pipe up to 4½"; rigid and thin-wall conduit; steel, brass and copper tubing; bus-bars.

CABLE PULLERS. Makes the tough job of cable pulling easy. Pulls cable into exposed or concealed conduit in half the time required with cumbersome equipment. Easily carried, operated by one man.

JOIST BORERS. The convenient, work-saving way to bore holes in joists for knob-and-tube wiring and for conduit. Ball bearing operation. Easily assembled.

KNOCKOUT TOOLS. Greenlee Knockout Punches and Knockout Cutters save hours of work in cutting smooth accurate holes. Enlarge holes without drilling, reaming or filing.

RADIO CHASSIS PUNCHES. A special Greenlee tool for cutting holes in radio chassis for sockets, plugs and other receptacles. Cuts or enlarges holes in a jiffy. A big time saver for the radio worker.

PIPE PUSHERS. One man easily pushes pipe through ground by powerful hydraulic action. Eliminates extensive trenching, tearing up lawns and pavement in installing pipe.

The Greenlee Hydraulic Bender above has been in use fourteen years at Squire Electric Co., Kansas City, Mo. C. F. Miles, General Superintendent, finds it cuts their labor hours in two on bending jobs. And he tells us it's especially valuable when uniform bends of the same radius are required.

Ask leading electrical contractors everywhere and you'll find Greenlee Benders the leaders in the field. Speed, accuracy, easy operation, portability and fast set-up . . . all make for important savings in time and materials. Smooth, accurate, uniform bends are produced in less time, with no kinks or serious damage to conduit finishes.

The well-equipped contractor knows good tools are essential to modern electrical installation work. And it's a vital matter under today's critical man-power conditions.

WRITE FOR FREE BENDER BOOKLET S-116

So get the facts now on Greenlee's complete line of hydraulic and hand benders for every bending job. Write for Bender Booklet S-116, also Catalog 33-E on Greenlee time-saving tools for electrical work. Greenlee Tool Co., 1744 Columbia Ave., Rockford, Ill.



Get Ready with Greenlee!

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN

VERNON M. MILLER (left) of Miller-Liskey Electric Co., Hagerstown, Md., has recently been re-elected as a director of the Electrical Contractors Assn. of Maryland. "Vernie" also has dabbled in politics having been a recent city councilman and runner-up in the recent election for mayor. He handles the estimating, buying and general management while his partner Robert B. Liskey, right, does the engineering, industrial motor and power work.

Maintenance and Servicing of Electrical Instruments

By

JAMES SPENCER

In charge of Instrument and Relay Department, Meter Division, Westinghouse Electric & Manufacturing Co., Newark, N. J.

REPRINTS AVAILABLE

This reprint should be of great value to all those whose problem it is to keep in operation the electrical instruments on vital war production as well as those on planes, signal equipment, tanks, ships, guns and other armament.

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This reprint should be useful to all instrument users, switchboard attendants, testing engineers, and instrument service men, as the accuracy and efficient life of instruments depend to a large extent on competent handling.

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SERVICING OF ELECTRICAL INSTRUMENTS.

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Practical Methods

[FROM PAGE 48]

up before the line contactor can be energized. This is a safety electrical-interlocking scheme that prevents starting the motor across the line in case the accelerating contactors are not functioning properly.

When the start button is pressed, coil 1A_m is energized, opening contact 1A and closing auxiliary contacts 1Aa₁ and 1Aa₂. Closing the auxiliary 1A contacts energizes coil 2A_m, opening 2A, closing 2Aa₁ and energizing coil M which closes line contact M, auxiliary contact Ma₁ (establishing holding circuit) and opens Ma₂ de-energizing 1A_m. De-energizing 1A_m starts timing the 1A contactor. Both 1A_m and 2A_m were energized when 2Aa₁ closed, but their action does not take effect until their respective main coils become de-energized. At the preset time, the contactor armature of 1A is opened, closing contact 1A and shorting-out a portion of the starting resistance. As 1A closes, the two auxiliary 1Aa contacts open; contactor coil 2A_m is de-energized, and 2A_m starts timing. At the preset time, the 2A contactor armature drops out, 2A closes shorting-out the remaining portion of the starting resistance and the motor comes up to full speed.

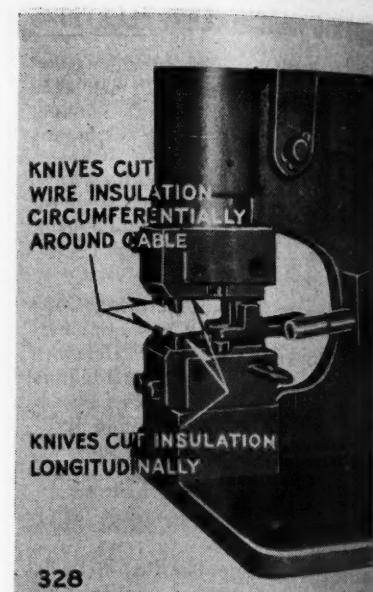
PRESS CUTS INSULATION FROM ELECTRIC CABLE

INDUSTRIAL

By H. C. POTTER*

The accepted method of skinning the insulation off the end of an electric cable preparatory to soldering into a terminal or making other electrical connections is to use a knife or hand pliers. This operation is slow and hazardous, and further, there is danger of severing one or more strands when "ringing" the wire with a knife, thus reducing the carrying capacity. Ringing solid wire weakens it to an extent that a few flexings may break it at that point.

The illustration shows a method of removing the insulation from the end of the cable without the hazardous task of using a knife. The press employs two front knife blades which are shaped for the particular size of cable to be skinned, in the same manner that hand pliers used by wiremen are shaped for the particular size wire being handled. These two knives cut around



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PRESS for cutting insulation from electric cable. Front knife blades cut around insulation; longitudinal knife blades cut insulation along cable.

the insulation without injuring the copper if properly adjusted. At right angles to these two front knife blades are two other blades. These are positioned in the middle of the round opening in the front knives so that when the press is closed, these two longitudinal knives cut the insulation lengthwise along the cable. In this manner the insulation is cut around the wire of the cable as well as along the cable, thus effectively removing it from the copper.

This operation is quicker than the hand operation and much easier. The knives are quickly changed to suit any size cable. One other feature is that the knives are not difficult to make or position.

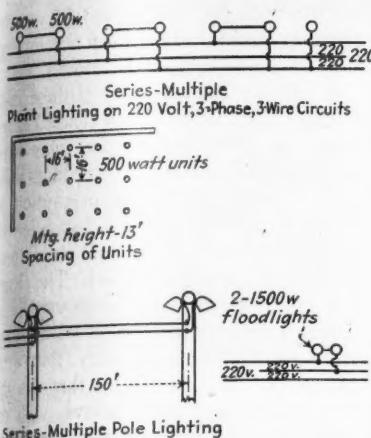
* Time & Motion Analyst, Westinghouse Electric & Manufacturing Co., Chicago, Ill.

SERIES-MULTIPLE LIGHTING SAVED MATERIAL

WIRING

When the W. T. McAuley Electric Company, Kansas City, Mo., was called in some time ago to relight a steel plant building, availability of materials was the most difficult problem to overcome. Transformers were practically unobtainable and the existing unit was too small to take care of the additional load required by the increase in lighting intensity. Copper had to be saved wherever possible.

There was ample capacity on the power circuits, so McAuley hit upon the idea of using a series-multiple sys-



DIAGRAMATIC SKETCH shows 220-volt series-multiple lighting system installed to save copper and transformer equipment.

tem on the three-phase, three-wire 220-volt power circuits. Two 500-watt incandescent lamps, connected in series across one of the 220-volt phases, constitutes a circuit. All groups of units are balanced equally across the three phases of the power circuits and are controlled from two 25-circuit distribution cabinets fed directly from the system. The one disadvantage—two lamps going out when one burns out—was not too objectionable in this case.

A total of 100 — 500-watt fixtures mounted on 16-foot centers, 13-ft. above the floor, illuminate the 150-ft. by 150-ft. building. Lighting intensity at the working plane is 27 foot-candles.

The same scheme was employed in the protective yard lighting. In this case poles, installed 150 feet apart were equipped with two 1,500-watt floodlights. The two units on each pole were series connected across one of the three phases of the 220-volt, 3-wire circuit feeding them.

"TRANSITE" DUCT SERVES OUTDOOR RECEPTACLES

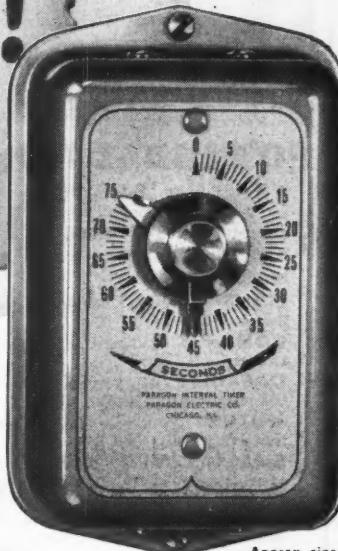
WIRING

If you were to visit the Oak Ordnance Plant in Illinois you would be amazed at the conservation of critical materials that was effected in the design of the electrical distribution system. Built at a time when conduit, copper and other electrical equipment was extremely hard to secure and when the armed services were in dire need of all the ammunition they could get, the engineers were forced to improvise wherever possible to get the plant into production.

Only in the most hazardous areas was any conduit used at all—and then [Continued on page 164]



PROTECT IT
WITH *Paragon*
TIME DELAY RELAYS



Approx. size
of 800 Series,
4 $\frac{1}{2}$ " high,
2 $\frac{1}{2}$ " wide,
1 $\frac{1}{4}$ " deep.

NOTHING is more vital to the war production program than electrical equipment. Guard it with Paragon automatically reset, synchronous motor operated time delay relays, which:

1. Protect rectifiers and tube filaments from application of plate current before filaments are preheated.
2. Control the various steps of motor acceleration.
3. Delay the closure of elevator control circuits.
4. Stagger the closure of multiple circuit systems so that full load will not be applied at start.

Paragon Time delay relays have countless uses . . . for example: machine tool control, therapeutic machine operation, controlling compressor bypass valves, split second control of light exposure in photographic, blue print and X-Ray work, operation of pneumatic tube carrier systems, etc.

Accuracy of the time cycle and operation of the timer not affected by changes in ambient temperature or vibration. Designed for panelboard mounting or may be mounted to standard handy box or single gang switch box.

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HULLHORST UNDERCUTTER



PORTABLE NO. 62

• Here is a light weight—compact—handy—portable mica undercutter ideally suited for industrial maintenance men and motor repair shop crews.

LIGHT WEIGHT—weighs only 4 lbs.

COMPACT—Gets into smaller spaces.

CAPACITY—Undercuts horizontal commutators up to 30" dia.

MOTOR—Light, powerful, ball bearing equipped.

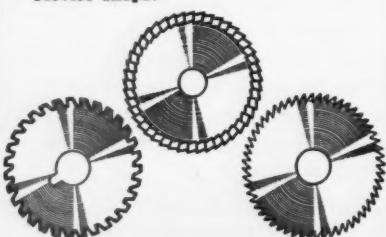
SMALL CUTTER—Allows smooth operation, gets closer to riser—lower cutter cost.

BLOWER—Ample for blowing mica dust away for best visibility.

SIMPLICITY—Fewer parts than most undercutters—no flexible shafts to give trouble.

The price of the No. 62 Undercutter with 110 Volt Universal DC motor or 25 to 75 cycle AC includes carrying case, bar, screw driver and 20 Hullhorst High Speed Steel (1/4") Cutters—4 each of .015", .025", .030", .035" thickness or assorted as you want them. Also furnished with 220 Volt Universal motor at slight increase in price.

HULLHORST
Mica Undercutter No. 10
A compact, high production, undercutting machine, handling armatures up to 6 1/2" in dia. and shafts up to 17 1/4" long. Built specifically for manufacturers and large electrical service shops.



HULLHORST High Speed Steel Commutator Saws

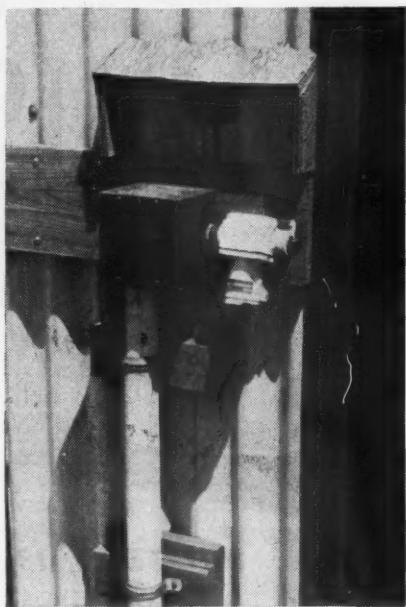
An adequate supply of all important standard sizes is carried in stock. Specify Hullhorst for—faster cutting—longer life—adaptability to all types of Mica Undercutters. In ordering give diameter, hole, thickness and purpose for which intended.

HULLHORST
MICRO TOOL CO.
Division of
TOLEDO STANDARD COMMUTATOR CO.
2242 SMEAD AVE.
TOLEDO 6, OHIO

Practical Methods

[FROM PAGE 163]

in limited quantities dictated by safety requirements. "Transite" ducts are used exclusively in outdoor and underground distribution circuits with stand-



OUTDOOR RECEPTACLES for vacuum cleaners are fed by "transite" ducts to reduce conduit use to a minimum. Receptacle is of the standard weatherproof, four-prong, grounded type.

ard switching and control equipment housed in "transite" cabinets.

This conduit conservation theme was carried even to the vacuum cleaner receptacles mounted on the building exterior of the long shell loading lines. The outlets are fed from an underground circuit through a "transite" duct riser terminating in a steel junction and splice box. Nipped to the side of this box is a standard weatherproof, four-prong, grounded receptacle

for use with the industrial type vacuum cleaners employed to keep the loading line interiors in hospital-room shape.

Each day the interiors of these shell loading lines are vacuum cleaned to remove all powder dust that may have accumulated on the floors, ceilings walls and equipment. This precaution is taken to insure against formation of powder dust "pockets" that would produce a very definite hazard. The cleaning units are equipped with explosion-proof motors and controls with a long rubber-covered, heavy-duty, four-wire, extension cord and plug that fits the receptacles mentioned above. All receptacles are conveniently located at regular intervals adjacent to the building doors for easy access.

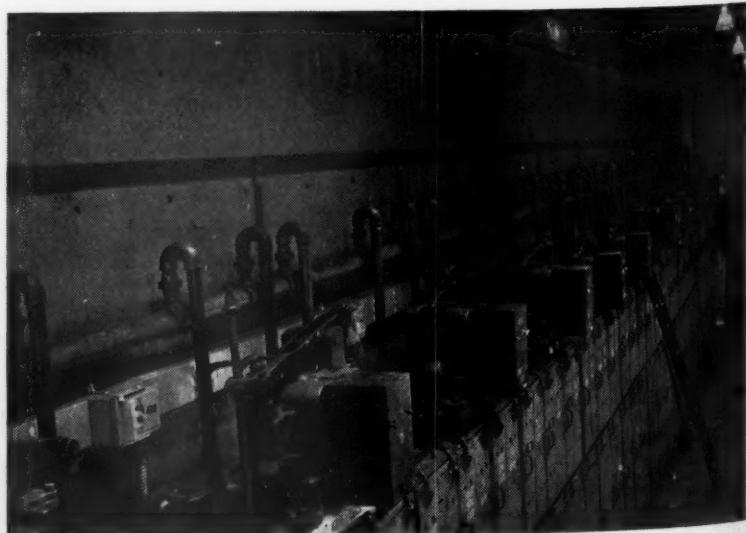
BUS DUCT FOR CONTROL CIRCUITS

WIRING

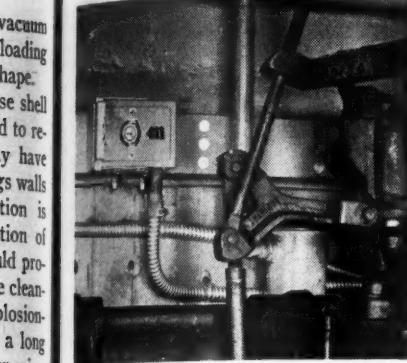
Plug-in type enclosed bus duct with tap-offs on 12-inch centers solved a difficult wiring problem within the limited space between a line of station auxiliary equipment controls and the back wall in a middle west utility property.

Because of the premium on working space behind the control units, a conventional conduit and wire system or open bus work would have proved impracticable. Hence a run of "12" Flex-A-Power with Flex-A-Plugs for branch taps was installed to feed current to the control units in the room. The duct was mounted to the concrete wall with special clamps furnished for that purpose.

The 12-inch spacing for duct taps provided the necessary flexibility needed to locate the tap-off switches as



TIGHT SQUEEZE behind line of utility station auxiliary control equipment is overcome by use of plug-in type of enclosed bus duct for feeding units.



CLOSE UP of duct and plug shows lack of working space behind control equipment and ease with which duct solved wiring problem.

near as practicable to the control units they serve. Conductors in flexible metallic tubing were used to connect the duct to the operating equipment.

IMPRINTED SHEETS FOR ENGINEERING DRAWINGS

INDUSTRIAL

By FRANK P. KUHL*

An engineering drawing usually has some form of title and change block and, in many instances, a border line. Where a quantity is used, imprinted sheets represent a definite saving in handwork and a uniformity of appearance.

To determine the most economical sizes for a series of imprinted sheets and a method of indicating changes and revisions, a study of existing practices and standards was made, which revealed a wide variance in details.

This study indicated that the standard letter size of 8½ by 11 inches might be used as a basis for determining a series of sheet sizes. Prints folded to these dimensions could then be filed together with correspondence, or filed separately, in standard letter files. Multiples of 8½ by 11 inches seemed to suggest a series of 11-in. by 17-in., 17-in. by 22-in., 22-in. by 34-in. and 34-in. by 44-in; each successive sheet size being twice the area of the preceding one. However, this did not prove economical, as the widths of standard rolls of tracing cloth, tracing paper, blue print paper, etc., progress in multiples of six inches, usually beginning at 24 inches. On this basis, a 34-in. wide sheet would have to be cut from a 36-in. wide roll, thus wasting 2 inches, or 5½ per cent, of both drawing and reproduction paper.

*Chief Draftsman, Consolidated Edison Co. of New York, Inc.
[Continued on page 166]

Outlasts five ordinary starters



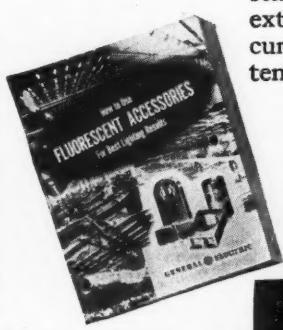
G-E Watch Dog Fluorescent Starters have gained nation-wide popularity with fixture manufacturers, lighting engineers and maintenance men because Watch Dogs substantially reduce maintenance costs. It isn't necessary to replace a starter each time a burned-out lamp is changed. Under specified test conditions the FS-40 outlasts an average of ten 40-watt fluorescent lamps, FS-100 . . . eight 100-watt lamps. This exceeds the approximate life of five ordinary starters.

Reason For The Watch Dog's Long Life

When a dying lamp reaches the end of its normal life, blinking and flickering start but the Watch Dog cuts itself out of the circuit. Since there is no flow of current, burned-out lamps are prevented from being started needlessly and the life of the starter is greatly extended. In addition, ballasts are protected and current is conserved. All this results in lower maintenance costs.

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Our new catalog tells how to use G-E Fluorescent Accessories for best lighting results. You can obtain your free copy by writing to Section G443-8, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.



GENERAL ELECTRIC

**"Bent conduit
is installed
as easily as
straight—**



—when you're using KONDU!"

And you can put up Kondu fittings close to corners, or right up against girders or partitions, just as easily as in the open.

The Harder the job, the More you appreciate Kondu. But it saves you time and money on every ordinary job, too. It's the easiest fitting to tighten up in perfect alignment.

Every Kondu fitting is a union, and can be taken out of the line without disturbing conduit.

Takes either Thin-Wall or Thick-Wall conduit, with either a Threadless or Threaded connection —at any outlet.

Vibration-proof... self-locking, permanently tight. Practically unbreakable, 100% re-usable. Write for the Kondu Catalog.

**KONDU CORPORATION
Erie, Pa.**



Practical Methods

[FROM PAGE 105]

or cloth. A roll 30-in. wide (which dimension usually runs from $\frac{1}{4}$ -in. to $\frac{3}{4}$ -in. greater for both paper and cloth) resulted in a series of 30-in. by 44-in., 22-in. by 30-in., 15-in. by 22-in., 11-in. by 15-in., and $8\frac{1}{2}$ -in. by 11-in. The last is a standard letter size sheet and is readily obtainable in cut form. Each sheet size was identified by a letter, the letter "A" being assigned to the largest because it was most commonly used and should be easily remembered by the draftsman. The successively smaller sizes were designated "B", "C", "D", and "E", respectively. The final folding size of prints from these sheets is $7\frac{1}{2}$ -in. by 11-in., which is suitable for filing in letter size cabinets, together with correspondence, and does not require accurate folding in order to remain within the limits of a standard size letter. The "D" and "E" size sheets are primarily intended for use in letter size binders.

Each sheet was provided with two title blocks, the main block being placed in the lower right hand corner and the auxiliary block in the upper left hand corner.

The auxiliary block was placed in an inverted position, containing only the drawing number and a short title, to be used primarily for filing purposes, and to eliminate the wear and tear that the main title block usually is subjected to from fingerprinting when looking for a drawing in a plan file. This fingering eventually causes the tracing fibres to break and accumulate dirt and, when reproduced, the image on this area of the drawing is either hard to read or

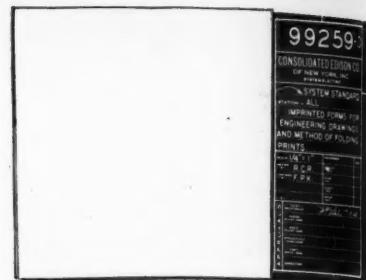


FIGURE 2—Folded blue print suitable for filing without the necessity of transcribing drawing number and title to outside of same.

entirely unreadable. The drawing, when filed, is placed in a horizontal plan file with the auxiliary block in the front of the drawer and on the right hand side.

The drawing number in the main title block was located so that it appears on the front of a folder print in the upper right hand corner with the title immediately underneath it. This makes the folder print suitable for filing in a standard letter file and eliminates the usual practice of transcribing the number and title to the outside of the folder print, see Figure 1. The method of folding prints is shown in Figure 2.

The revision or change block was placed at the extreme right of the sheet, running from the top to the main title block (Figure 2). This location makes it unnecessary for the draftsman to rest his hand on the body of the drawing while making notations and avoids soiling from perspiration. It further allows an engineer to study a number of revised tracings, stack them in a sheaf, and sign them without danger of blotting.

To eliminate the arrow and number method of indicating changed areas, a border line was placed around the drawing. This was subdivided into co-

[Continued on page 173]

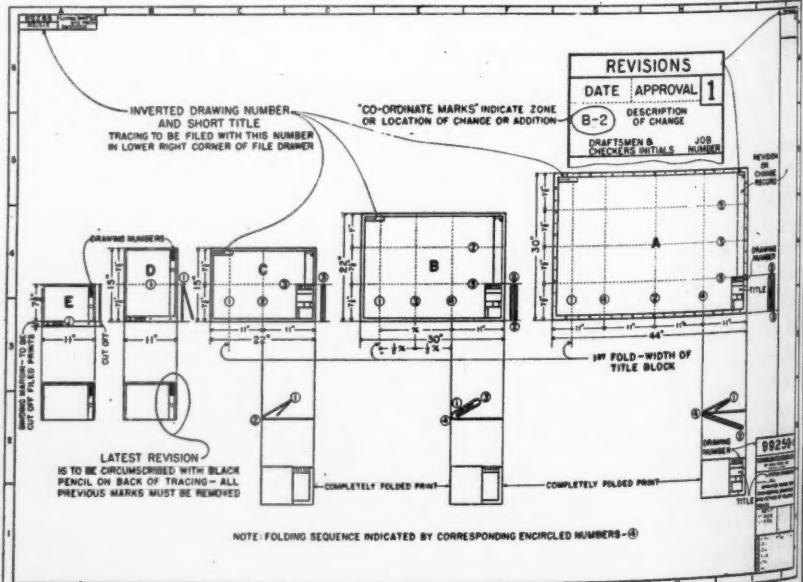


FIGURE 1—Imprinted sheet, showing title blocks, coordinate-marked border, revision block, and method of folding prints.

ordinate zones identified vertically with numbers and horizontally with letters, which are indicated in Figure 2. The coordinate marks, locating the zone in which the change occurred, are noted in the revision block together with a description of the change and constitute a permanent record. Thus an affected area may be quickly located, which is highly desirable on construction and assembly drawings. To simplify still further the finding of a change, the affected area is circumscribed on the back of the tracing with a heavy pencil line which at all times indicates the latest revision, and which is always removed when a subsequent revision occurs. Each change or revision is identified by either a letter or number which follows a dash placed after the drawing number. Letters are used to indicate an issue of prints made while the drawing is in the development stage and numerals are used to indicate changes after the drawing has been completed and has been issued for construction. Thus the letter "A" in the complete drawing number 100000-A would signify the first issue during the development stage, the letter "B", the second issue, and so forth. The numeral "0" in the complete drawing number 100000-0 would indicate the first issue of the completed drawing, while the numeral "1" in place of the "0" would indicate that the first change or revision had occurred after the completion of the drawing.

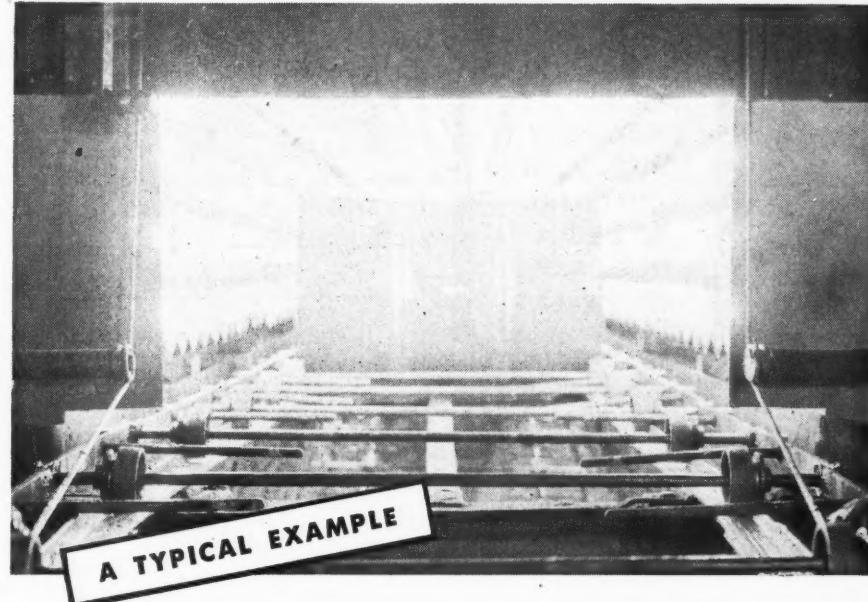
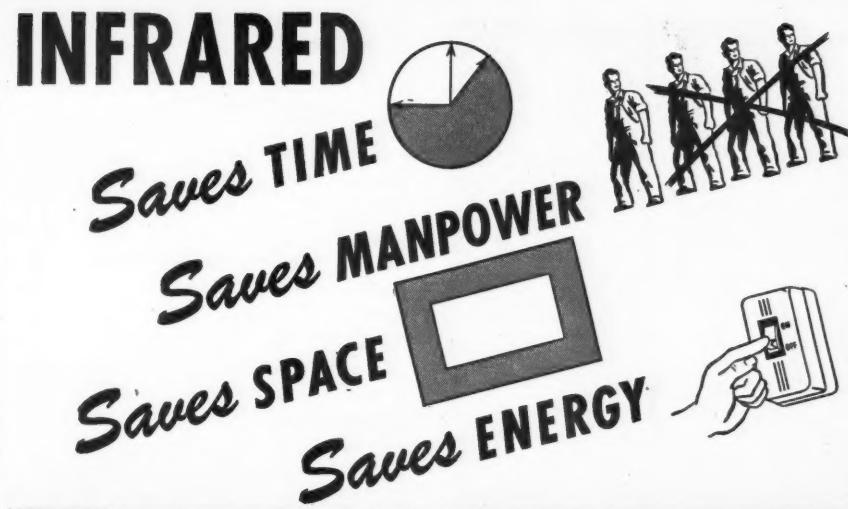
These details, while seemingly inconsequential, do really add much to the appearance and better use of the products of the drawing room.

HOW DEDIMENTIAL IS LOW POWER FACTOR

INDUSTRIAL

We are all cognizant of the fact that the intangible phenomenon called Power Factor has a direct bearing on the efficient operation of an electrical system. That low lagging power factor materially reduces the useful capacity of conductors and equipment, increases electrical losses, increases voltage drop, and in general reduces a healthy electrical system to a crippled state, is no secret.

Just how detrimental low power factor can be is clearly illustrated by the attendant comparative table presented by N. M. Mintz of Chicago, a power factor application engineer representing the Cornell-Dubilier Electric Corp., during a recent talk before Chicago electrical contractors and motor shop men. The chart takes you down [Continued on page 168]



Throughout industry, greatly increased efficiency in baking, drying, dehydrating and preheating operations have resulted by utilization of the Near Infrared Process. One of many typical examples is the finish baking on steel drums at the Draper Manufacturing Co. In continuous line production passing thru a 60 ft. Infrared tunnel, 55 gal. drums are finish baked in less than 6 minutes. In a second tunnel, 44 ft. long, 100 lb. grease drums are also finish baked in 6 minutes. In a third tunnel, 11 ft. long, drums are dried at the rate of 250 per hour after leak testing in water. Considerable savings in floor space and manpower needs were made by these installations. Case histories of Infrared applicable to your particular application are available on request.

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JENKINS
Gold Seal Tape
FRICTION . . . RUBBER

Practical Methods

[FROM PAGE 167]

happens to the electrical system at each step along the way.

Column 1 is the power factor ladder divided into 10-percent steps. What happens to current as the power factor is varied is pictured in Column 2. For example: If 100 amperes were required at the end of a circuit having a 60 percent power factor, the conductors would have to be large enough to carry the 167 amperes required at the source. Raising this power factor to 90 percent would reduce the necessary circuit amperes to 111; if unity power factor were attained, the circuit current would be the load current of 100 amperes.

Obviously, if higher circuit currents are required at lower power factors, assuming of course a constant load

power factor to increase the capacity of existing conductors on inductive load circuits and thus eliminate the need for more wiring to carry additional loads.

To handle the same load, electrical equipment must have a larger capacity at low power factor conditions. It's obvious that in order to deliver 100 amperes at the end of a 60 percent power factor circuit, a transformer must be large enough to provide the 167 amperes needed on the conductors (see column 2). Comparative transformer sizes needed at various power factor values are presented in Column 5 of the table. As power factor decreases, KVA increases

$$(KVA = \frac{K.W.}{P.F.})$$

Hence, low power factor means increased investment in electrical equipment.

Voltage drop increases as power factor decreases, since the reactive cur-

EFFECT OF VARYING POWER FACTOR

| 1 Power Factor % | 2 Current in Amperes % | 3 Comparative Conductor Size | 4 Comparative Weight of Copper Pounds per 1,000 Ft. | 5 Comparative Transformer Size Per Cent | 6 Comparative Voltage Drop % | 7 Comparative Energy Loss in Conductors Per Cent | 8 Comparative Load Capacity in % of Load at 50% P. F. |
|---------------------|---------------------------|---------------------------------|--|--|---------------------------------|---|--|
| 100 | 100 | 1/0 | 319 | 100 | 2.0 | 2.0 | 200 |
| 90 | 111 | 2/0 | 403 | 111 | 2.2 | 2.5 | 180 |
| 80 | 125 | 3/0 | 508 | 125 | 2.5 | 3.1 | 160 |
| 70 | 143 | 4/0 | 640 | 143 | 2.9 | 4.1 | 140 |
| 60 | 167 | 250,000 | 772 | 167 | 3.3 | 5.6 | 120 |
| 50 | 200 | 300,000 | 926 | 200 | 4.0 | 8.0 | 100 |
| 40 | 250 | 500,000 | 1540 | 250 | 5.0 | 12.5 | 80 |
| 30 | 333 | 750,000 | 2320 | 333 | 6.7 | 22.2 | 60 |
| 20 | 500 | ... | ... | 500 | 10.0 | 50.1 | 40 |
| 10 | 1000 | ... | ... | 1000 | 20.0 | 200.4 | 20 |
| 0 | ... | ... | ... | ... | ... | ... | ... |

STUDY THIS TABLE and see for yourself what power factor correction can do for an electrical system—in terms of increased capacity, reduction of losses and more economical use of equipment.

current, the size and capacity of the conductors are directly affected. Weights of copper installed would also vary as the conductors increased or decreased in size. This relationship is clearly illustrated in Columns 3 and 4 which indicate the comparative sizes and weights of conductors at various power factor conditions. For the example cited above, 250,000 CM cables would be necessary at 60 percent power factor while No. 2/0 would do the job at 90 percent power factor. Column 4 shows that .772 lb. of copper per foot of conductor would be required in the low power factor condition compared to .403 lb./ft. at the higher power factor.

The story these two columns tell clearly indicate the value of raising

current of inductive loads introduces a voltage drop which subtracts vectorially from the applied voltage. Likewise, the energy (I^2R) losses increase as power factor falls. Columns 6 and 7 present the comparative effect of varying power factor on voltage drop and energy losses.

A picture of the comparative load capacity in percent of load at 50 percent power factor is given in column 8 of the table.

The ravages of low power factor (lagging) are somewhat difficult to picture. This table is presented with the idea of giving a visual impression of the effects of such a condition on the efficient operation of an electrical system.

WARTIME OVEN

When Clinard Electric Company of Winston-Salem, N. C. was burnt completely out of their original quarters some time ago, it remained for E. A. Kellette, Clinard's engineer in charge of motor repair, to build a new shop from scratch with any materials that might be available.

His new 10 kw. electric bake oven was one of the results. The oven sides and end are built of solid brick. The ceiling is supported by half-inch pipe-lengths spanning the oven width on four inch centers. Ceiling insulation is provided by a layer of sand evenly distributed four inches deep over the steel plate top.

Heating units are mounted around the bottom of the oven about twelve inches above the floor. The 220 volt

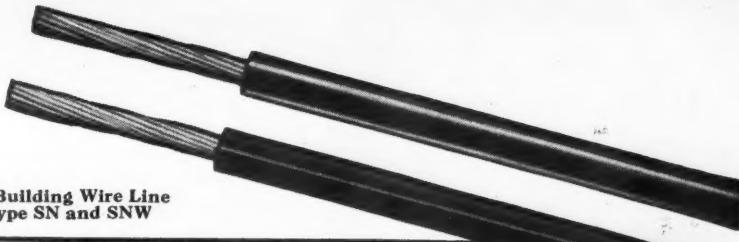


SOLID BRICK BAKING OVEN
built quickly under emergency conditions. Note the cleat and knob wiring of the resistance heating units. Sand is used on roof for ceiling insulation.

3 phase interior distribution is run on cleats and knobs with uninsulated wire. Natural ventilation is provided by a fresh air intake under the oven door with damper-controlled vent in ceiling to the outside air. The oven is completely automatic with thermostat and time-clock control.

The truck which rolls into the oven is provided with side frames that can carry lengths of pipe supporting motor coils for baking. Large casters on the truck make easy rolling in and out of the oven. Two lengths of angle iron are used as track to guide the truck casters in and out of this oven.
[Continued on page 173]

Flamenol Building Wire Line includes Type SN and SNW



In Wet Locations USE **TYPE SNW FLAMENOL*** **BUILDING WIRE**

(Small Diameter)

Simplify wiring installations by using Flamenol Building Wire for entire jobs: standard Type SN Flamenol wire for the dry locations; Type SNW for the wet locations. Type SN Flamenol wire has proved its worth over a period of years. The new Type SNW Flamenol wire has all the good features of Type SN Flamenol wire and in addition has a special thermoplastic insulation with low moisture absorption. It is approved by the Underwriters' in sizes 14 to 4/0 inclusive for use in raceways in wet locations as follows:

1. Underground
2. In concrete slabs or masonry in direct contact with the earth
3. In wet locations
4. Where the condensation and accumulation of moisture within the raceway is likely to occur.

Type SNW Flamenol wire like Type SN is small in diameter, light in weight and easy to install. The insulation of both these wires has long life, is high in dielectric and mechanical strength and is resistant to oils, acids and alkalies. For further information see the nearest G-E Merchandise Distributor or mail the coupon for folders containing detailed information.

*Reg. U.S. Pat. Off.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news, every weekday 6:45 P.M. EWT, CBS.

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Section W441-8
Appliance and Merchandise Dept.
Bridgeport, Conn.

Sirs: Please send me the folders on Type SNW and Type SN Flamenol Small Diameter Building Wire.

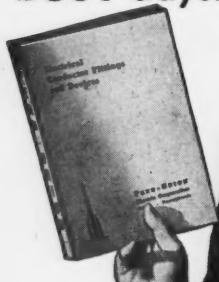
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City _____ State _____

GENERAL  **ELECTRIC**

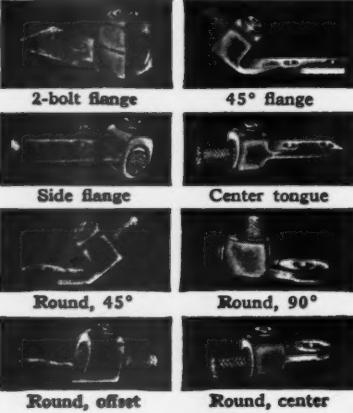
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BUSY days!"



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JUST FOR EXAMPLE—here are some of the standard Penn-Union Vittite terminal lugs:



These types and many more—in a complete range of sizes. Write for Catalog.

Penn-Union connectors are the first choice of leading utilities, industrials, electrical manufacturers and contractors. They have found that "Penn-Union" on a fitting is their best guarantee of Dependability.

PENN-UNION
ELECTRIC CORPORATION
ERIE, PA. Sold by Leading Jobbers

PENN-UNION

Conductor Fittings

Motor Shops

[FROM PAGE 169]

Mr. Kellette claims that this oven, which was built quickly to meet a pressing demand, is producing better results than any he has ever used.

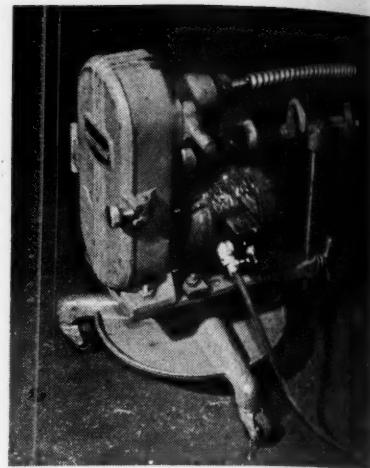
PORTABLE GRINDER A HANDY SHOP TOOL

Time consuming hand work is reduced to a minimum in the motor service shop of the Scherer Electric Company, Indianapolis, Indiana. Whenever possible power equipment has taken over. One of the chores, formerly done by hand but now motorized, is the numerous applications of grinding and sanding in motor shop work.

A portable flexible-shaft grinder is the friend of all the mechanics in the shop. It is most frequently used during the final assembly of rewound motors to remove the film of varnish that is baked on the inside of the rotor bore. For this operation, a 2-inch diameter, 1½-in. face, 50 grit, abrasive band on a rubber arbor is used. Shaft speed is 2,450 r.p.m. Now, only a few minutes is required to "polish" the face of the stator slots on an average size motor. Larger motors, of course, require a correspondingly longer time.

The power unit is a compact Walker-Turner drive consisting of a ½ hp., single-phase, 110-volt, 3,450 r.p.m. motor with a four-step cone pulley speed changer. The complete assembly is mounted on a tripod base equipped with casters, facilitating the use of the unit anywhere in the shop.

By simply changing the type of wheel at the end of the flexible shaft, and in



POWER UNIT consists of a portable assembly of a 110-volt, single-phase motor with a four-step cone pulley speed changer. It can be used anywhere in the shop.

some cases the speed, the unit can be used for numerous other grinding and polishing applications. It is particularly handy for grinding down welding beads, cleaning armature slots, removing paint, rust, and cleaning metal surfaces. The addition of a drill chuck to the end of the flexible shaft transforms the unit into a handy electric drill for hard-to-get-at places.

CRADLES FOR ARMATURE WORK

In the Electrical Equipment Company motor repair shop of Richmond, Va., adjustable armature cradles are provided at each bench. The bench is specially built to accommodate the adjustable arms.

The bench top is wooden planking 2½ inches thick with a two-inch space directly beneath. In this space, hollow steel stock two inches square and as long as the bench is deep, is used for the extension arms. The steel stock is vertically slotted so that retaining bolts can be dropped through the bench top to prevent the arms from being accidentally pulled all the way out.

On the end of each arm is mounted a brass V-block which is padded with fiber strips to protect threaded ends of shafts and bearing surfaces.

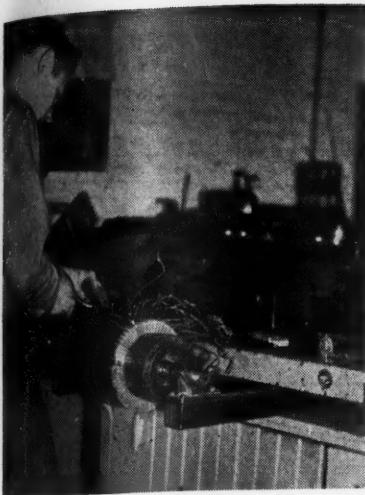
The arms can be moved out or laterally to any width to accommodate any size armature. They may also be pulled out longitudinally to a distance that will clear the circumference of the armature.

The device is extremely handy in that the bench with the worker's tools is always within easy reach. Further, when not in use, the arms can be pushed in and out of the way.

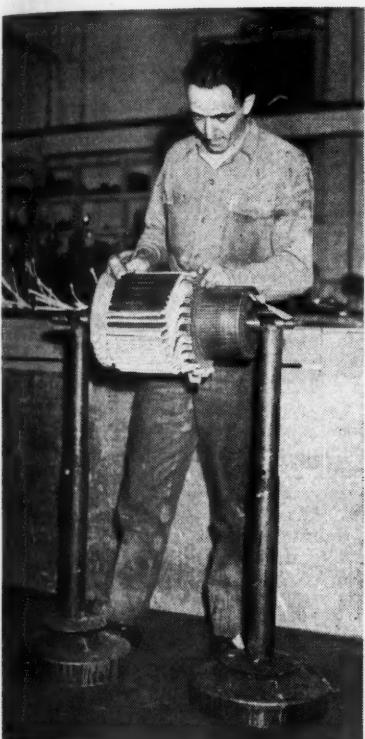
A portable cradle stand is also pro-



VARNISH FILM vanishes from the face of the bore in this stator, as operator manipulates flexible shaft sanding drum.



ADJUSTABLE ARMS that can be moved laterally or longitudinally to accommodate any size armature.

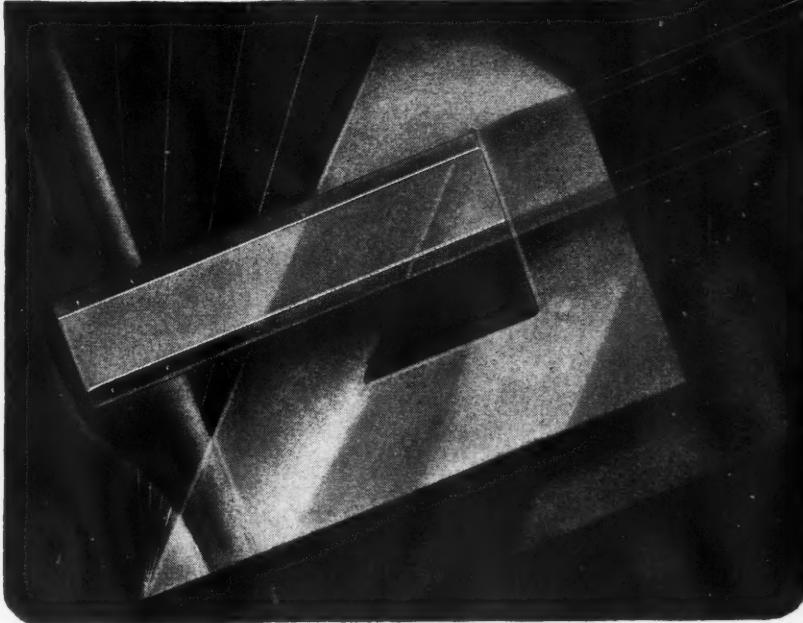


TWO BRAKE DRUMS, four lengths of pipe, two pieces of angle iron and two steel pins make an adjustable armature cradle that can't be beat for usefulness.

vided in addition to those in the benches. The base of each stand is an old automobile brake drum. To the drum is welded an 18-inch length of heavy 2½-inch pipe drilled diametrically near the top to accommodate a ½-inch pin. Inside the 2½-inch length is inserted a 30-inch length of heavy 2-inch pipe. Five holes are drilled in this length on three inch centers starting at the bottom. This gives five points of vertical adjustment at the option of the worker.

V-blocks are provided in the top of the two-inch lengths by inserting the [Continued on page 172]

engineering +



engineering+sound planning = increased sales

RITTENHOUSE engineers today are creating the better, the more perfect Rittenhouse Chimes of Tomorrow.

Improved mechanical principles made possible through the use of new materials, new manufacturing methods and a new high standard of Rittenhouse workmanship will bring new simplicity of design, a *lengthened life-time* of new, care-free performance, and new beauty.

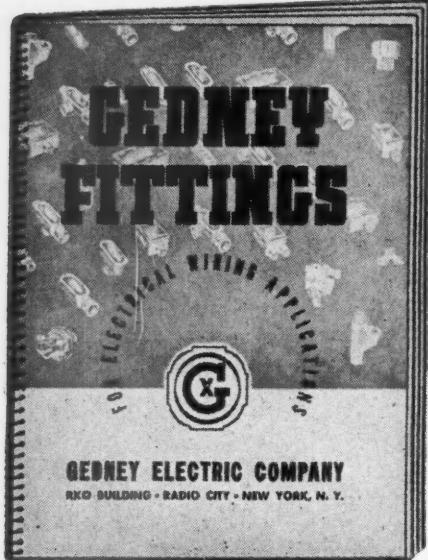
The knowledge gained from the engineering and manufacturing of complex wartime electrical systems, linked with 40 years of distinguished pre-war accomplishment, guarantees this new Rittenhouse Chime perfection.

That's why the better chimes of the future will be Rittenhouse made. And that's why, if you consider Rittenhouse now in your postwar plans—you'll remember Rittenhouse when peacetime sales begin.

THE A. E. RITTENHOUSE COMPANY, INC.
Honeoye Falls, New York

Rittenhouse
DOOR CHIMES

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HELPFUL DATA ON
GEDNEY
FITTINGS**



"Gedney Fittings Fit"
SOLD THROUGH WHOLESALERS
GEDNEY ELECTRIC COMPANY
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Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.

**NORTH AMERICAN
ELECTRIC LAMP CO.**

1044 Tyler Street St. Louis 6, Missouri

Motor Shops

[FROM PAGE 171]

vertex of a short piece of 3½-inch angle iron. The piece is welded to the top of the pipe, and then padded with a thin layer of fiber to protect shaft bearing surfaces.

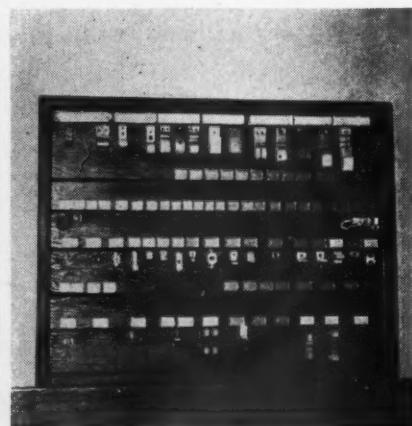
PARTS DISPLAY AIDS CUSTOMERS

Undoubtedly many motor service shops have had customers come into the shop and ask for—"a gadget that looks something like this" or some such vague description of a part that they need. The Industrial Electric Service Co., Joliet, Ill., has had this experience and decided to do something about it. The net result was the development of two display boards and a showcase for displaying bulky parts and accessories.

One display board contains a sample of every type of carbon brush that the shop stocks. Tabs under each row of brushes contain the catalog numbers and the stock bin or drawer number. The brushes are glued to the board to prevent damage in the event they might be needed for an emergency repair.

For displaying bulkier parts and accessories, Otto Pohlers, shop owner, uses an ordinary showcase. Here he has samples of bearings, large contactors, automatic switches and other motor and control parts numbering between 800 and 1,000 pieces. Each part in the case is tagged bearing the actual part number and stock bin identification.

Mr. Pohlers has these displays in the office section of his building and attests to their time saving value. It tends to



CONTACT DISPLAY board serves a useful purpose in the contactor renewal department. Broken and burned contactors or parts can be compared with those mounted on the board.

KNOW ELECTRICITY AS EXPERTS KNOW IT



-AND GET AN EXPERT'S PAY

What about your future? Who is safe today? Surely not the man who is contented to stand still! Know your job thoroughly—prepare yourself for jobs ahead. To do just this thousands of men have used

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7 Volumes, 2906 pages
1948 how-to-do-it illustrations

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• Croft tells you the things you need to know about motors, generators, armatures, commutators, transformers, circuits, switchboards, distribution systems—electrical machinery of every type—illumination in its every phase—the most improved methods of lighting—lamps and lamp effects, etc.—how to do a complete job, from planning it, to completion.

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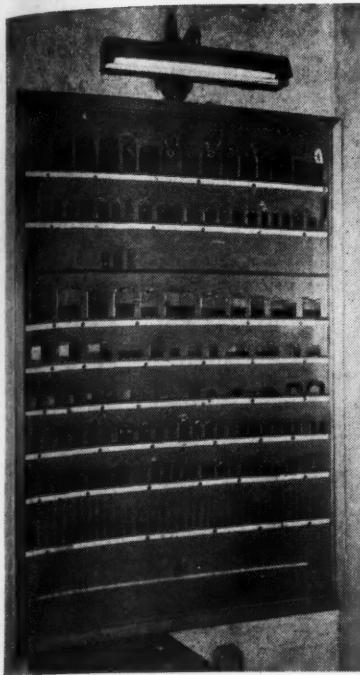
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AND SEE THE BOOKS FOR YOURSELF

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You may send me the seven volumes of the Croft Library of Practical Electricity for 10 days' examination. I agree to return the books, postpaid, in ten days or remit \$3.00 then and \$3.00 a month until the special price of \$18.00 has been paid. (To insure prompt shipment, write plainly and in all lines.)

Name
Home Address
City and State
Position
Name of Company EC-4-1



BRUSH DISPLAY board in this motor shop office has samples of more than 200 carbon brushes kept in stock. It provides the customer with an opportunity of comparing his damaged sample with the renewal brush he needs.

eliminate considerable misunderstanding, confusion, word picture descriptions and in some cases even arguments. In addition it advertises the large number of parts and accessories that his organization keeps in stock for the customers benefit.

Modern Lighting

[FROM PAGE 78]

proceeded down the line, pulling wire and making splices.

The job was almost completed before the fixtures finally arrived, and the moment they were delivered, all three scaffold crews went to work doubling back, from section to section through the fire walls, installing fixtures and lamping.

Despite the delay in fixture delivery, and despite the fact that the crews had to double back to finish the job, the first building was lamed and lighted within 22 days from the time Roy Robinson was notified he would have only 35 days for each building. The second was completed and crews were out of the depot in another 18 days.

Profiting by experience gained in wiring the first building, four days time was saved in wiring the second; and the entire job was completed 30 days ahead of schedule.

[Continued on Page 174]

USE G-E TEXTOLITE SOCKETS in All Locations



You can use these sockets in hundreds of places—factories, mills, warehouses, stores, homes, etc. They are strong, have excellent insulating qualities and are good looking too. What is more they will retain their pleasing appearance. Pull, push, key and keyless types are available.

The interior of these sockets is one piece and totally enclosed. Caps and shells are self-insulated and will not rust, corrode, flake, or tarnish. No "liners" are needed. A threaded catch connection holds cap and shell together securely. Standard shade-holder threads will hold shades tightly.

For further information see the nearest G-E Merchandise Distributor or write to Section D441-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

Hear the General Electric radio programs:
"The G-E All-girl Orchestra" Sunday 10
P.M. EWT, NBC. "The World Today"
news every weekday 6:45 P.M. EWT, CBS.

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IMMEDIATE DELIVERIES

CHICAGO TOGGLE BOLTS

You can't beat these dependable Chicago Toggle Bolts for fastening to lath, plaster, hollow tile or any type of hollow wall. Furnished in 25 sizes from $\frac{1}{8}$ x 2" to $\frac{1}{2}$ x 6". All types of screw heads or toggle-head riveted on with nut. Immediate deliveries. Call your wholesaler. Write for Catalog on Chicago Anchoring devices.

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ILSCO Electrical Connectors



Buy conductivity . . . not weight!

MAIL THIS
COUPON
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Please rush us sample and
32-page illustrated catalog.

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CINCINNATI, OHIO

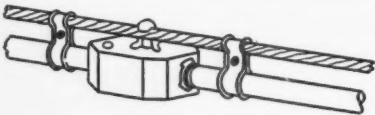
Modern Lighting

[FROM PAGE 173]

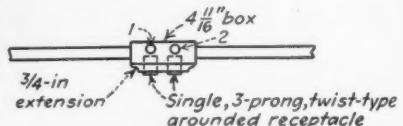
LIGHTING A PIPE FABRICATION SHOP

Good quality lighting is essential in all phases of industrial operations, particularly in layout departments, with the required intensity depending largely upon the type of material handled. That is the premise upon which Briner Electric Co., St. Louis electrical contractors, base their lighting sales and installation activities.

That was the basis of their recommendations when they were called in to do something about the lighting in the layout department of a midwestern pipe fabrication plant. The work in this department consists of assembling sections of large pipe, bent according to specified contours, with valves and flanges inserted at specified intervals. Once the various sections, valves and flanges are matched according to plan, they are tackwelded in place and sent



Detail of Outlet Support
Fixtures are suspended from conduit



Detail of Single Receptacles on Alternate
Circuits
①, ② - Circuit designation

MOUNTING DETAILS show the method of supporting the steel octagon outlet boxes; also the single, twist-type, grounded receptacles installed with extension ring covers to provide adequate working area in outlet.

to another department where a complete welding job is done. All work is done on layout tables, 30 inches above the floor and measuring, in most cases, 15-ft. by 15-ft.

Original Lighting — The existing lighting was of extremely poor quality. A total of six fixtures, each containing three mercury lamps operating—one lamp per phase—on a 3-phase, 220-volt system, provided only two to three foot-candles on the working plane in the 60-ft. by 50-ft. area.

New Lighting System—Recommendations led to the installation of a continuous-line fluorescent system utilizing the 100-watt, 3,500° K. white lamps. Three continuous rows of Day-Brite units, mounted end-to-end, and spaced

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Here is the kind of book you have been awaiting—an ABC book which will show any electrical worker or salesman of electrical supplies what electronics is all about. This book gives you simply—without formulas or much mathematics just what you want to know about electronic principles and how they are applied in working devices.

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A PRIMER OF ELECTRONICS

By DON P. CAVERLY
Commercial Engineer,
Sylvania Electric Products, Inc.

235 pages, 5½ x 8½, Illustrated, \$2.00
Here is an especially clear and simple explanation of electronics and electronic tubes and circuits, for all concerned with the manufacture, application, or operation of household or industrial electronic devices.

• The text is concise and written in language that anyone can understand, yet is technically authoritative and complete.

• More than 200 specially prepared illustrations are an important factor in the clarity of the treatment.

• The material has grown out of the widely-known series of articles in *Wholesaler's Salesman*.

The book begins with the atom, the electron, and static and electron discharges and takes the reader step by step through explanation of electric current, magnetism, and electromagnetic radiation, to an understanding of simple radio tubes, fluorescent lamps, cathode ray tubes, ignitron, thyratron, and other tubes and their basic connections for practical purposes.

The book covers concisely, practically, so that any one may understand, such topics as: production of radio waves; reception of radio waves; short-wave radio; frequency modulation; television transmission; television reception; ultra-high frequencies and microwaves; ranging and directing by radio; infrared; ultra-violet; hot cathode fluorescent light sources; fluorescent-lamp circuits; cold cathode fluorescent light sources; bactericidal tubes; stroboscopes; photo-electric tubes; cathode-ray tubes; iconoscopes; image-dissector tubes; facsimile recorder tube; X-ray tubes; electron microscope; electron tubes in general.

**See it 10 days
on approval**

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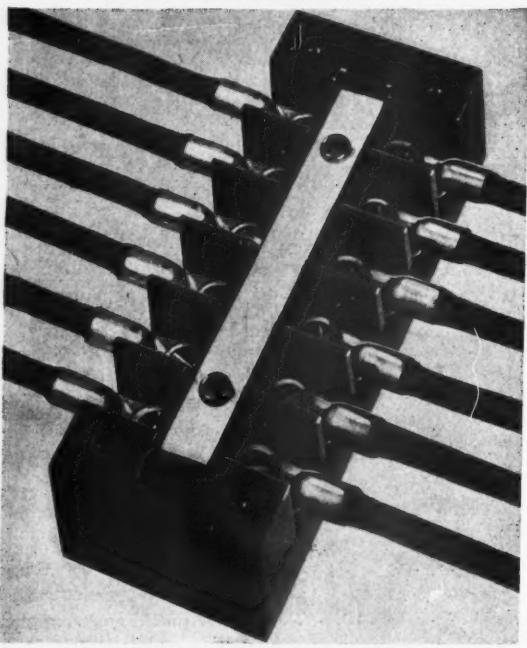
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(Books sent on approval in U. S. and Canada only.)

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TERMINAL BLOCKS...

BURKE bakelite Terminal Blocks moulded under enormous pressure in hardened steel moulds—10 styles for 2 to 12 wires. Designed to go into Dispatching and Traffic Signal Systems, Switchboard, Fire and Patrol Signal Systems, etc. Impervious to moisture—high electrical resistance—fast to install and economical.

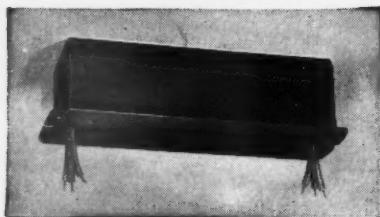
• Write Dept. C.T.B. for folder and prices.



BURKE SERIES 7000-50 AMP. BLOCKS

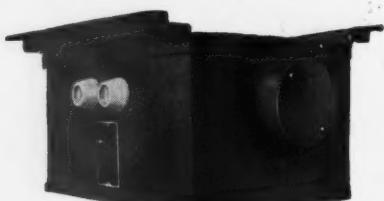
AC AND DC MOTORS AND GENERATORS
BURKE Terminal BLOCKS
BURKE ELECTRIC COMPANY • ERIE, PENNSYLVANIA

FOR MODERN EFFICIENT LIGHTING



ACME FLUORESCENT LAMP BALLASTS

Now available in designs and sizes to meet W.P.B. regulations. Write for Bulletin 157-157A.



COLD CATHODE LIGHTING TRANSFORMERS

Familiarize yourself now with this new form of lighting. Write for Bulletin 162.

THE ACME ELECTRIC & MFG. CO.
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THE AUSTIN LINE MARINE ELECTRICAL EQUIPMENT

Combination Switch and Receptacle Boxes—W. T. and N. W. T.—double pole, single throw-switch, and single-phase receptacles.



Single, Double, and Triple Receptacle Boxes—W. T. and N. W. T.—single phase.



Branch Boxes—W. T. and N. W. T.—have no fuses and are used to connect branch circuits. Branch Junction Boxes are fusible.



AUSTIN Marine Products, some of which are shown here, are made to the highest engineering standards, carefully inspected and packed, and fully approved by the U. S. Navy. Send for Marine Catalog No. 9-S-2 for complete details on the AUSTIN line.

Lamp Type Indicator Boxes—Watertight. Furnished complete with clear green, red, blue, yellow and opal lenses.

THE M. B. AUSTIN COMPANY
108-116 S. DESPLAINES ST., CHICAGO,

Electrical Living in 1944

[FROM PAGE 47]

Too often the laundry is thought of in terms of washing machine and hand iron load. The modern laundry in the home of tomorrow will consist of an automatic cycle washer, a drier, an ironer, and a water heater, for a total average consumption of 3800 kilowatt hours annually. The value of the complete laundry as a consumer of kilowatt hours, coupled with maximum satisfaction to its owners, cannot be over-emphasized.

Again, the advent of the Precipitron, as a practical home device that assures in air supply free from dust and with low bacteria count,—and the Home Freeze Locker—when added to the heating and cooling system, bring to the utility room a total load of 2700 kilowatt hours.

194X Products Will Come

When the war is over, the crucial problem of all industry will be one of *re-conversion with minimum unemployment*. This means that the manufacturer must get back into the production of the things that he was making when the clouds of war descended. The tools, the techniques, the materials, the production lines can be more easily converted to 1942 products than to wait for new tools, new techniques, new materials that entirely new products would require. It is therefore, only sound, sensible thinking to anticipate that the equipment and materials will be the same or similar to those with which we built in 1942. To be sure, these may carry a new dress, but fundamentally, 1942 products should be anticipated for the immediate post-war period.

Please do not misunderstand me. I believe that many of the elements and materials and products which we have seen displayed across the pages of our forward-thinking publications and have heard expounded from the stage and press, as "Items of Tomorrow" will eventually become a fact.

Product and design history, however, has been one of organized improvement year after year, through research and development—step by step. New materials require new techniques, new machinery, reasonable periods of testing before the reputable manufacturer is prepared to place them on the market for consumer use, and this evolutionary process applies to housing as well.

Motor Shop Layout Speeds Repairs [FROM PAGE 44]

by burning the twisted leads into a welded joint by use of an oxy-acetylene torch, and stator is given another test for correct connections, opens and short-circuits.

Armatures go to the armature bench where they are wound and commutators replaced. Leads are cleaned and the windings are checked for shorts and grounds. Soldering leads into the commutator is done in a soldering pot—horizontal commutators getting a straight-down dip while vertical commutators are rotated at an angle through the solder.

Stators and armatures are dipped and baked, and then go to the storage area where they are placed in their respective trays. Trays then are taken to the machining areas and proceed as just described for those motors requiring minor repair.

Large Equipment Repair

Since the volume of large equipment handled is only a fraction of the number of small motors, the same mass production techniques cannot be used as effectively. However, a straight-through procedure is used. That is, the motor is taken to the far end of the shop after test, disassembly and stripping, where coils are wound, slots are insulated, coils are inserted and connections are soldered; and in the process, the frame (or armature) moves closer, step by step to the receiving end where it is dipped, baked, tested and shipped. At the same time that parts to be rewound are delivered to the winding area, the mechanical parts are delivered to the machine area (directly across the main aisle) where they await return of the frames from the bake oven.

Handling of copper in the winding department has become an easy, fast and efficient operation. An American Mono-Rail track has been installed to carry chain-falls from the stock shelves into the motor and transformer coil winding departments. The Mono-Rail track is built in a U shape around the coil stock-racks to facilitate handling of coils from both sides. As can be seen in one of the accompanying pictures, the motor-coil winding department is handled by one side of the U track. To get coils down to the transformer winding department, a Mono-Rail track switch had to be installed at the vertex of the U. A

[Continued on page 178]

Simplex-Tirex

Flexible Cords and Cables

Now Have "Synthetic Rubber" Insulation and Sheath



Many of the industries now classed as "essential" have used millions of feet of TIREX - rubber sheathed - cords and cables. During the war their demands for TIREX have increased to such an extent that little has been left for normal commercial uses. Mines, shipyards, railroads, and other vital war activities have needed every foot that could be made.

At the same time, the sources of supply of natural rubber have been cut off and available stocks have been reduced until rubber can be used only for purposes where no substitute can be found. It can no longer be used in sheath compounds for cable - and only in insulation for a very few types of cable where service requirements preclude the use of synthetic materials. Synthetic insulations and sheaths have replaced rubber compounds and the new materials have, in many instances, exceeded expectations both mechanically and electrically.

In flexibility, toughness, abrasion resistance and safety, the TIREX of today - we call it "WAR-TIREX" - approximates pre-war TIREX standards. In essential industries doing important war work Simplex WAR-TIREX cords and cables are doing an outstanding job. Performance records indicate that synthetic insulations and sheaths may have an important place in postwar work.

If you need flexible cords or cables for portable electrical tools or mobile equipment, we shall be pleased to tell you how Simplex WAR-TIREX can serve you.

Simplex WIRES and CABLES
Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

ELECTRICITY

For Any Job—Anywhere

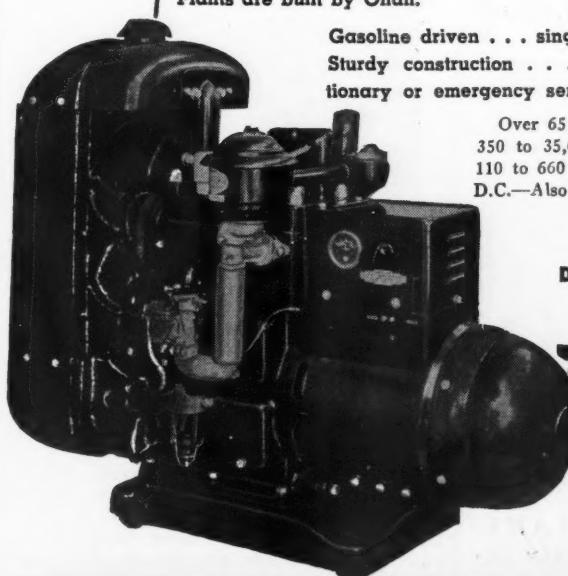
For a dependable source of electricity on projects remote from commercial power, Onan Electric Plants are proven leaders in the field. More than half of the Armed Forces' total requirements for Power Plants are built by Onan.

Gasoline driven . . . single-unit, compact design . . . Sturdy construction . . . Suitable for mobile, stationary or emergency service.

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Descriptive literature sent promptly on request.

D. W. ONAN & SONS
2088 Royalston Ave.
Minneapolis, Minn.



ONAN
ELECTRIC PLANTS

Motor Shop Layout Speeds Repair [FROM PAGE 177]

PROFITABLE Opportunities for you with AUTOMATIC TIME CLOCKS

Window Lights . . . Electric and Gaseous Tube Signs . . . Apartment and Hotel Hall Lights . . . Billboards . . . Flood Lighting . . . Poultry House Lighting . . . Linetypewriter Machines . . . Pumps and Motors . . . Electric Refrigerator Defrosting . . . Time Lock Safes and Vaults . . . Street Lighting Systems . . . Traffic Signals . . . Signal and Alarm Systems . . . Appliance Outlets . . . Water Softening Equipment . . . Advertising Displays . . . Ventilating Systems . . . Attic and Exhaust Fans . . . Electric Fountains . . . Air Conditioning Equipment . . . Electric Hot Water Heaters . . . Compressors . . . Oil Well Pumps . . . Battery Charging . . . Sprinkling Systems . . . Airport Lighting . . . Church Bulletin Boards . . . Dieramas . . . Coal Stokers . . . Time Signals . . . Chemiculture . . . Paint Agitators . . . Blowers . . . Yard Lighting Systems . . . Bulletin Boards . . . Heat Treating . . . Panoramas . . . Conveyors . . . Suburban Railway Station Platforms . . . Chimney Systems . . . Electric Cookers . . . Factory Lighting . . . Electric Glue Pots . . . Park and Playground Lights . . . Gas and Oil Heating Equipment . . . Plastic Molding . . . Solenoid Valves . . . Greenhouse Lights.

Write for Information and Discounts

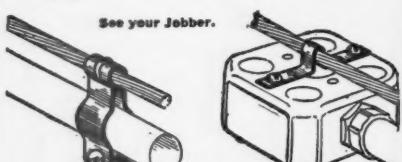
AUTOMATIC
Electric Manufacturing Co.
TIME SWITCHES—FLASHERS
MANKATO • MINNESOTA



New Practical Unit to Cut Installation Time

The "Messenger Hanger" and the "Messenger Strap" fill all the need for an economical, practical, time-saving unit for use with the new messenger cable type of installation. Mechanically strong, durable, lightweight. They save considerable material and are easily and quickly installed. Our bulletin gives full and complete details—send for it.

See your Jobber.



"Messenger Hanger" for Conduit and Cable Strong, made of Cadmium Plated Steel or Everdur. For messenger cable installations to permit conduit to be put in place without falling off.

"Messenger Strap" for Outlet Boxes Of Cadmium Plated Steel or Everdur. For messenger cable installations to fit used with Minerallac "Messenger Hanger". Fits all standard outlet boxes and $\frac{3}{8}$ " messenger cable.

MINERALAC
ELECTRIC COMPANY
New York City Office 50 CHURCH ST.
THEODORE B. DALY
25 N. Peoria St. Chicago

spur of track was then installed from the switch to serve the transformer area.

An electric jib crane has also increased handling efficiency. The I-beam boom swings through an arc of about 270 degrees and serves part of the machine area and part of the winding area.

The large equipment division also has a dynamometer for testing large motors. Although not a routine test, the dynamometer is used extensively at customer request and also for verification and information tests. A large test board provides any combination of voltages (in steps of 15 to 20 volts) up to 600 volts at one, two or three phase. A double throw, three pole switch in conjunction with an autotransformer (formerly used as a reduced voltage starter) is now used in the test transformer primary leads to obtain additional voltage steps. The test transformers are double wound, with a great number of taps in the secondary. All transformer tap leads are brought to the test board and terminate in jack-and-plug receptacles.

All motors and transformers are given standard tests before shipment.

The third operating division of the company is construction and industrial maintenance. Its operations are equally interesting and efficient and deserve lengthy treatment, but space limitation permits only mentioning it.



THE MIRACLES of industrial chemistry in the synthetic field are revealed to St. Louis, Mo., electrical maintenance men by Samuel J. Rosch, manager insulated products development, Anaconda Wire and Cable Co. Here he exhibits a length of synthetically insulated coaxial cable widely used in radar and television.

ELECTRICAL CONTRACTORS

**SAVE
FUSING
WORRY..**



Insure dependability
with
**UNDERWRITERS'
APPROVED**

LITTELFUSES

Approval to Littlefuses from 3 to 8 amps, 250 V., greatly widens uses. For electric appliances—heavy duty power supplies—amplifiers—motors—radios, etc.

1/100 to 1/2 amp.

Littlefuse Slo-Blo construction. High time lag. For surges, and intermittent duty.

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Straight link type. Control to prevent oxidation. Clean dependable service.

4 to 8 amps.

New sleeve type. Sleeve takes pressure shocks on short circuits.

Catalog shows fuses for protection of every instrument and circuit. Write



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GENERAL
LIGHTING



MULTI is a complete line of Fluorescent and Incandescent units for residential and commercial installations. No two jobs require the same fixture and contractors know that if they rely on MULTI they will have the correct unit to meet the most exacting demands—they are the modern answer to present needs.

• Send for Complete Catalog

MULTI
ELECTRICAL MANUFACTURING CO.
1840 W. 14TH ST., CHICAGO, ILL

Outdoor Grounding and Testing Techniques

[FROM PAGE 59]

of a portable testing instrument which gives a direct reading of the ground resistance value. Energy is supplied by a battery or hand operated generator—an integral part of the instrument.

The Three-Point Method—requires two auxiliary ground rods located similar to those in the above method, except that their resistance values should be approximately the same as the permanent rod being tested. Three separate tests are made to determine the resistance of each of the series circuits composed of the two grounds (see Fig. 8-B). The unknown resistance to earth R_x of the permanent ground rod is then calculated by using the following formula:

$$R_x = \frac{1}{2} (R_1 + R_2 - R_3)$$

The Ammeter-Voltmeter Method—is another means of determining ground resistances. Auxiliary rods are also needed (see Fig. 8-C for diagram). The resistances of the ground circuits are determined from the meter readings and are then used in the above formula to determine R_x . Any error due to stray direct currents in the earth can be corrected—one of them taken with the test current reversed.

The Fall of Potential Method—utilizes an ammeter and voltmeter with either a direct or alternating current source and two auxiliary grounds (see Fig. 8-D). The current supply with ammeter is connected between the permanent ground and furthermost auxiliary ground while the voltmeter (preferably a high resistance type) is connected between the permanent ground and second auxiliary one midway between the two. The resistance R_x is then computed from the formula

$$E : R_x = I$$

Using a Calculation Graph—This method, developed by the Division of Safety and Fire Prevention of the Pure Oil Company involves the use of two auxiliary grounds approximately 20 feet apart and not less than 20 feet from the permanent ground. The resistance between each pair of rods is measured with an ohmmeter, using insulated leads. Average values of two readings for each resistance (R_1, R_2, R_3), using reversed polarity, are used to compensate for stray ground currents.

WHERE TO BUY

Equipment, Materials and Supplies for Electrical Construction—Maintenance—Repairs

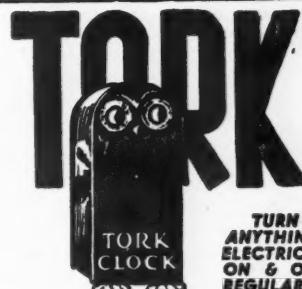
DRILLS CONCRETE—METAL—WOOD



WODACK "DO-ALL" ELECTRIC HAMMER AND DRILL

Saves time and money installing expansion anchors. Drills concrete to $1\frac{1}{2}$ " dia.; metal to $\frac{3}{8}$ ". Two tools in one. Easy to maintain. Universal motor. Star drills in 17 diameters. Also chisels, bull points, etc. Write for bulletin.

Wodack Electric Tool Corporation
4628 W. Huron St., Chicago 44, Ill.
Telephone AUSTIN 9886



TURN
ANYTHING
ELECTRICAL
ON & OFF
REGULARLY

The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK

If this or other advertising does not supply the information concerning products or services wanted, please write:

ELECTRICAL CONTRACTING
330 W. 42nd St., New York 18, N. Y.



for SAFETY'S SAKE SODER-FLUX

Underwriters' Approved
L. B. ALLEN CO., INC.
6715 Bryn Mawr Ave., Chicago 31, Ill.

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(Classified Advertising)

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10 CENTS A WORD. MINIMUM CHARGE \$2.00. Positions Wanted (full or part time salaried employment only), $\frac{1}{2}$ the above rates payable in advance.

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(Copy for new advertisements received by April 19th will appear in May issue subject to space limitations)

IDLE Equipment Is WASTED Equipment

... and just as great a loss as it would be if insufficient power slowed up vital machinery scheduled for capacity war production.

Have you idle equipment that you no longer need? Possibly, it can be taken out of the "waste" classification and put to work—NOW—in some plant, somewhere, in urgent need for it.

Let used equipment dealers or advertising in the Searchlight Section help you "channel" your IDLE equipment to the war production front.



ELECTRIC EQUIPMENT CO.
63 Curlew St., Rochester, N.Y.
Tel: Glenwood 6783

FOR SALE New Rheostats & Switches

25—Catalog #61-013B Ward Leonard rheostats 4 ohm 7 amp 600 maximum volts.

19—Back connected Trumbull Switches 3 pole 30 amps 250 volt fused.

Immediate Delivery at Our Cost

GREAT LAKES ELECTRIC & EQUIPMENT COMPANY

16 N. Union St., Rochester 4, N. Y.

Make PERMANENT Connections Quickly



HOW TO handle every type of electrical job

—quickly
—accurately

Thousands have used this famous handbook as a working guide of everyday usefulness. NOW it is ready to help you too, in a big 5th edition — 600 pages larger — up-to-date — more than ever the one great pocket-book of practical electricity for you.

Croft's AMERICAN ELECTRICIANS' HANDBOOK

Revised by C. C. Carr, Pratt Institute

This book is packed from cover to cover with the facts every man doing electrical work needs to have constantly at hand—from fundamentals of electricity to remedies for electrical equipment troubles. Helps you install commercial electrical apparatus and materials intelligently, operate electrical equipment efficiently, and maintain it at high operating efficiency.

10 DAYS' FREE EXAMINATION

McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y.
Send me Croft's American Electricians' Handbook for 10 days' examination on approval. In 10 days I will send \$5.00 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

Name
Address
City and State
Position
Company FEC-4-44

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**AN Improved
SIZE 4 STARTER
WITH
FIVE NEW FEATURES**

...SMALLER - QUIETER...

Improved blow-out coils have fewer turns and are wound with heavier copper—assuring less heating effect, and efficient interruption of stalled rotor currents for electric motors up to 100 horsepower.

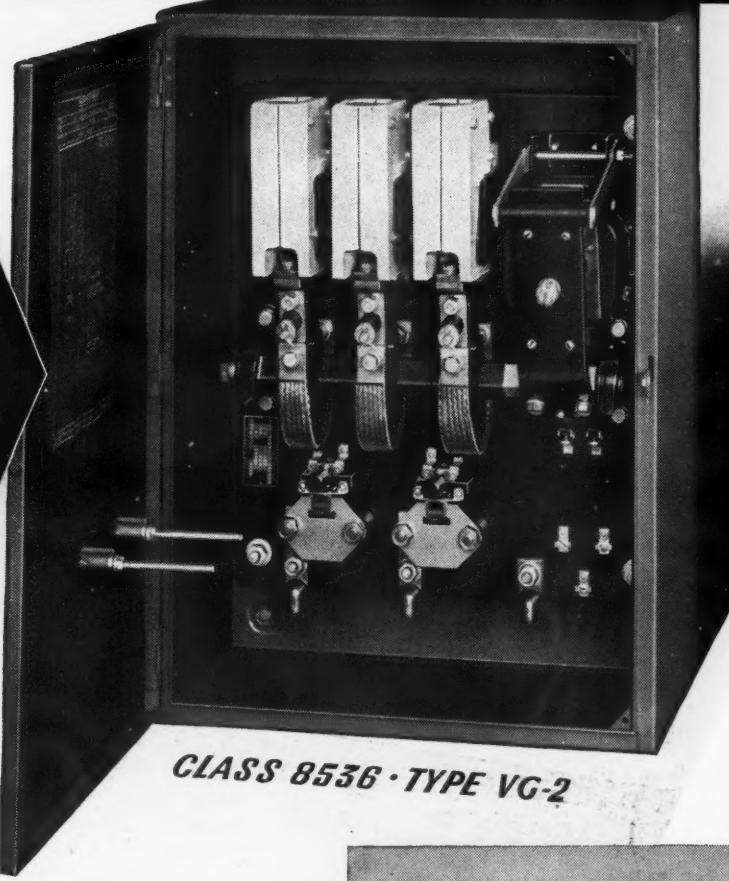
New and larger magnet of modified "E" type construction gives added efficiency.

Self-aligning, floating armature eliminates vibration noise—reduces heating and magnet wear.

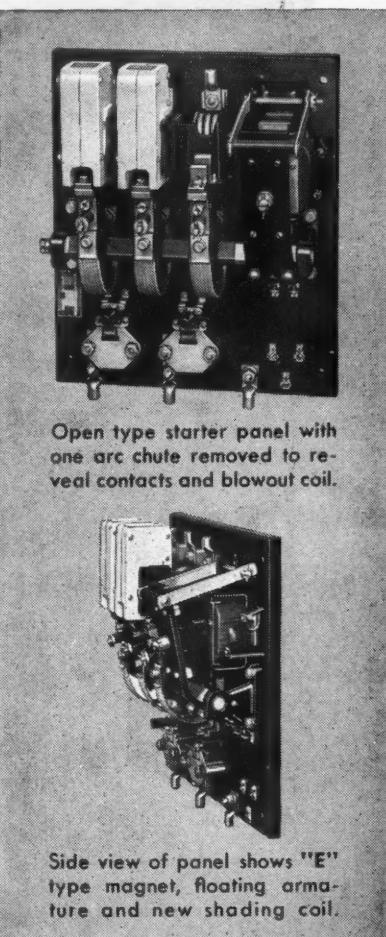
New shading coil affords exceptional mechanical strength. This coil is held in place by the magnet coil in such a manner as to prevent its falling out. Use of heavy brass ribbon makes shading coil virtually unbreakable.

Narrower panel saves space and flat door cabinet permits gang mounting.

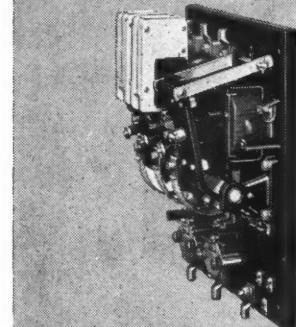
This greatly improved Type V device is available in a complete range of enclosures for all Size 4 starter applications, including reversing, combination, multi-speed, reduced voltage, etc. Call in or write your nearest Square D Field Engineer for complete information.



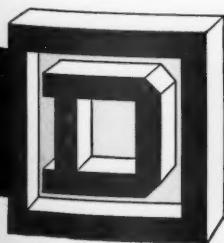
CLASS 8536 · TYPE VG-2



Open type starter panel with one arc chute removed to reveal contacts and blowout coil.



Side view of panel shows "E" type magnet, floating armature and new shading coil.



ELECTRICAL EQUIPMENT

KOLLMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

DETROIT

MILWAUKEE

LOS ANGELES

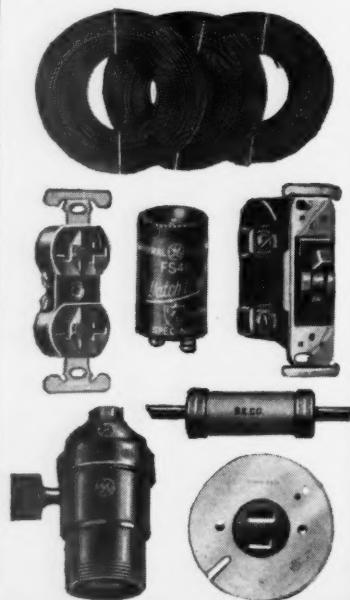
Local Service Everywhere on
G-E
RIGID CONDUIT



**G-E BUILDING WIRES
AND WIRING DEVICES**

The G-E wiring materials line also includes building wires and wiring devices for every purpose: Flamenol* Types SN and SNW small diameter building wires with thermo-plastic insulation; other wires; and switches, lamp-holders, outlets, fuses, etc.

*Reg. U.S. Pat. Off.



HEAR the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC. "The World Today" news every weekday 6:45 p.m. EWT, CBS.

BUY WAR BONDS

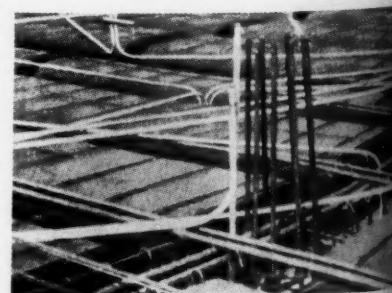
GENERAL ELECTRIC

Stocks of high quality G-E Rigid conduit are strategically located with G-E merchandise distributors all over the country. You can obtain either G-E White conduit or G-E Black conduit right in your own territory. Think of the time this saves. G-E rigid conduit saves installation time too. It is easy to handle, has accurate threads and its smooth finish aids wire pulling.

Both G-E White and G-E Black are leaders in their classes. They provide the utmost in wiring protection. G-E White is hot-dipped galvanized and Glyptal coated inside and out. This method of manufacture provides a heavier coating of pure zinc than could be applied in any other way. G-E Black has a tough asphaltic-base enamel coating baked on inside and out, which remains chemically inert in the presence of corrosive liquids or fumes.

G-E ELECTRICAL METALLIC TUBING

G-E high quality electrical metallic tubing is ideal to use for wiring system protection when chances of mechanical injury or corrosion are not severe. It is made from open hearth steel and is electrogalvanized on the outside and black enamelled on the inside. It bends easily and accurately. Compression fittings are available.



For Further Information on G-E rigid conduit, electrical metallic tubing, building wires or wiring devices, see the nearest G-E Merchandise Distributor or write to Section CDW-441-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

The
ELE